Vol. XXXV OCTOBER, 1951 No. 5

THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

CONTENTS

Studies on Foliar Diagnosis: I. Nitrogen Relations	*J. R. Velasco and R. P. Novero*	223
The Influence on Red Globe Onion of Different Amounts of Surface and Subsurface Irrigation Water	*Andres P. Aglibut and Frank L. Taclay*	233
The First Ratoon, First-Generation Plant Canes, and Parents of (POJ 2878 × P.S.A. 14) F_1 Seedlings	*Valeriano C. Calma and Roman R. Anday*	252
The Influence of 2,4-D Sprays on Melons and Watermelons with Special Reference to Seediness and Weight of the Fruits	*José M. Capinpin and Narciso M. Natividad*	260
Making Grass Silage	*Nestor C. Vera Cruz*	266
The Correlation Between Weights of Live and Dressed Hogs and Their Wholesale Cuts in Calamba, Laguna	*Magdaleno R. Elazegui*	273
College and Alumni Notes		280

Published by

THE COLLEGE OF AGRICULTURE AND
CENTRAL EXPERIMENT STATION

UNIVERSITY OF THE PHILIPPINES

COMMONWEALTH MYCOLOGICAL INSTITUTE
24 JAN 1953

The Philippine Agriculturist

(University of the Philippines Publications Series A)

Editor

L. B. UICHANCO, SC.D. ..... *Dean, College of Agriculture*

Managing Editor

G. O. OCFEMIA, PH.D. ..... *Professor of Plant Pathology*

Copy Editor

NORA J. CRUZ, A.B. ..... *Instructor in English*

Business Manager

JOSÉ M. CAPINPIN, PH.D. ..... *Associate Professor of Agricultural Botany*

Advisory Board

F. O. SANTOS, PH.D. ..... *Head, Department of Agricultural Chemistry*

VALENTE VILLEGAS, PH.D. ..... *Head, Department of Animal Husbandry*

FRANCISCO M. SACAY, PH.D. ..... *Head, Department of Agricultural Education*

LEON G. GONZALEZ, PH.D. ..... *Head, Department of Agronomy*

A. B. CATAMBAY, M.S. ..... *Head, Department of Agricultural Engineering*

SILVERIO M. CENDAÑA, PH.D. ..... *Assistant Head, Department of Entomology*

NICOLAS L. GALVEZ, PH.D. ..... *Acting Head, Department of Soils*

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

THE PHILIPPINE AGRICULTURIST is published monthly, except in April and May, beginning with Volume 35, by the College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed to the Library, College of Agriculture and Central Experiment Station, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

STUDIES ON FOLIAR DIAGNOSIS: I. NITROGEN RELATIONS [1]

J. R. VELASCO and R. P. NOVERO

WITH TWO TEXT FIGURES

The present investigation was conducted to determine whether or not foliar diagnosis can be a reliable method of ascertaining the amount of nitrogenous fertilizer needed by rice on a given soil.

Previous studies in this College (Trelease, 1920; Trelease and Jurado, 1920; Macasaet, 1935; Enrile, 1938; Talamisan, 1938; Topacio, 1938; and Cabotaje, 1941) have shown that our Lipa clay loam soil needs only nitrogen in order to grow a good crop of rice. The addition of phosphatic and potassic fertilizers is not beneficial, if not altogether harmful. A similar finding was reported by Mitra and Gupta (1950) on Indian (Uttar Pradesh) soil.

If the composition of the nutrient solution were used as an index of the nutritional need of the plant, it would be noted that the ionic ratio of nitrogen to either potassium or phosphorus in Espino's best 4-salt solution for rice is 6:1 (Espino, 1920). In other words, the plants need six times as much nitrogen as potassium or phosphorus. Considering further that most of our soils contain liberal amounts of phosphorus and potassium but inadequate nitrogen (Macasaet, 1935; Galvez, 1936), the reason behind the effectiveness of the nitrogenous fertilizer application would not be hard to see.

METHOD OF STUDY

The total nitrogen except nitrate was determined according to the official method of the A.O.A.C. (1945). Nitrate was not included because it was not present in the leaves of the rice plants in this study.

The distillation setup (fig. 1) was very similar to that proposed by Ynalvez (1938). The only additional features were the one-way check valve at the end of the steam inlet (A) (fig. 2) and the steam pressure regulator (B). Whereas in the original setup the digest usually was sucked back to the steam generator when the electric current went down, in the present device this could not occur. The steam pressure regulator prevented excessive steam pressure and the consequent distilling over of the alkali to the receiver.

EXPERIMENTAL ASPECT

Determination of the right leaf to sample. There is a difference of opinion among workers as to the method of sampling to follow.

---

[1] Central Experiment Station Contribution No. 1621. Based in part on the thesis of the junior author presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1951.

[The Philippine Agriculturist, Vol. 35, No. 4, September, 1951, appeared in September, 1952]
THE PHILIPPINE AGRICULTURIST VOL. 35, No. 5, OCTOBER, 1951.

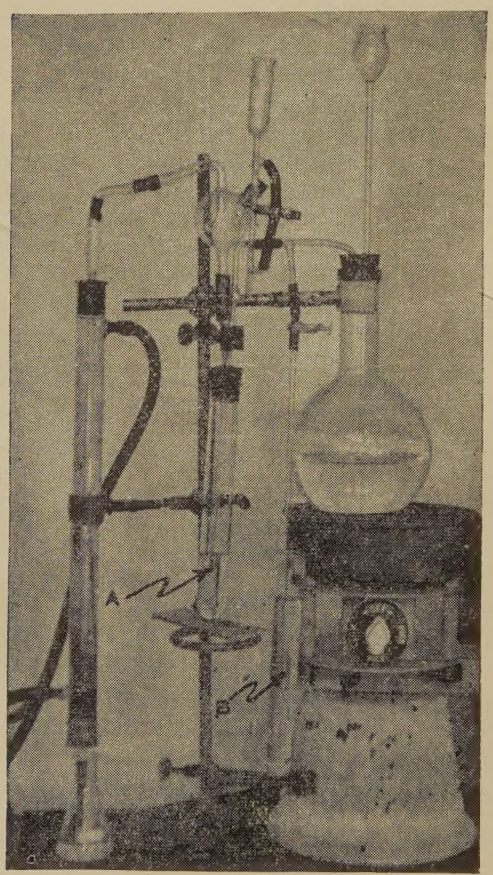

Fig. 1.—Steam distillation apparatus for the determination of total nitrogen. *A* is the end of the steam inlet with a glass bead to serve as a one-way check valve. *B* is the by-pass for excess steam. *Photograph by Dr. Julian Banzon.*

Thomas (1937) believed that any leaf on the stem, preferably the next to the caducous leaf, could be used. On the other hand, Ulrich (1943) found that the biggest difference in leaf composition of normal and deficient plants was manifested in the "most recently matured leaves."

Fig. 2.—The end of the steam inlet (*A*) in fig. 1, enlarged to show the glass bead.

Since there was no unanimity of opinion as to which particular leaf to sample, the writers thought it pertinent to find something on this point. On January 10, 1951, some seeds of the Elon-elon variety were planted on subsoil of Lipa clay loam. The subsoil or "tuff" was chosen because it contains, in general, a low percentage of nitrogen and fairly sufficient phosphorus and potassium (Macasaet, 1935). The object was to grow the plants in a nitrogen-deficient medium so that the effect of the application of nitrogenous fertilizer would be very marked.

When the plants were 45 days old, one lot was fertilized with ammonium sulfate at the rate of 4 grams to a five-gallon can (about 700 kg/ha.). Six days after fertilization, the different leaves were sampled for moisture and total nitrogen. At the time of sampling, the fertilized plants had dark green leaves. It seemed that on fertilization, the youngest leaves were the first to turn dark green, followed by the older leaves and the oldest living leaves in basipetal succession. The plants that were not fertilized had unhealthy, pale green leaves.

The leaves were numbered consecutively from 1 (the youngest leaf) to 4 (the oldest). The data on moisture content are presented in table 1 and those on total nitrogen, in table 2. There seemed to be no appreciable difference in moisture content between the corresponding leaves of the fertilized and unfertilized plants. The

leaves of the rice plants tended to decrease in moisture content as they grew older.

The nitrogen content varied significantly in the leaves of the same plant and in corresponding leaves of fertilized and unfertilized plants. The biggest difference was between the second youngest leaves of the two treatments.

To secure more information on the relation between the nitrogen contents of the different leaves and of the medium, the writers germinated some seeds on February 9, 1951. The seedlings were grown in Espino's best 4-salt solution for 45 days. Then one lot was transferred to a solution which was deficient in nitrogen. The composition of the complete and nitrogen-deficient solutions are presented below:

SALT	COMPLETE	—N	—P	—Mg	—K	—Ca	—S
(In milliliters of molar stock solution for each liter of the culture solution)							
$Ca(NO_3)_2$	0.375	—	0.375	0.375	0.375	—	0.375
$(NH_4)_2SO_4$ ...	0.375	—	0.375	0.375	0.375	0.375	—
$MgSO_4$	1.000	1.000	1.000	—	1.000	1.000	—
KH_2PO_4	0.250	0.250	—	0.250	—	0.250	0.250
$CaCl_2$	—	0.375	—	—	—	—	—
Na_2SO_4	—	0.375	—	1.000	—	—	—
KCl	—	—	0.250	—	—	—	—
NaH_2PO_4	—	—	—	—	0.250	—	—
$NaNO_3$	—	—	—	—	—	0.375	—
NH_4Cl	—	—	—	—	—	—	0.375
$MgCl_2$	—	—	—	—	—	—	1.000

On April 7 and April 10, 1951, leaves were sampled for total nitrogen. Tables 3a and 3b present the data obtained. Three days after treatment, there was no visual difference between the normal plants and the nitrogen-deficient plants. However, the nitrogen contents of the youngest leaves of the plants in the complete solution were significantly higher than those of the corresponding leaves of the plants in the nitrogen-deficient solution.

We may picture nitrogen deficiency as affecting two general metabolic processes. It retards the synthesis of nitrogenous compounds in plants and promotes the degradation of nitrogenous compounds. In general, synthesis is predominant in the young leaves, and degradation is more pronounced in the old leaves. The data (table 3a) seem to show that withholding nitrogen from the medium immediately affects synthesis but does not affect degradation.

Six days after treatment, the nitrogen content of all the leaves in the deficient lot decreased. The decrease was greatest in the

youngest leaves and next greatest in the next older leaves (table 3b). This was slightly different from what was found in the soil-grown plants, probably because of the relative state of leaf development. The youngest leaves in the soil-grown plants were not fully developed at the time of sampling, whereas those in the present experiment had just attained maturity.

Because of the more immediate effect on the young leaves of changes in nitrogen level in the medium (table 3a) and the greater difference between the corresponding "just mature" leaves in the two treatments (table 2 and 3b), the writers decided to use the "just mature" leaves in a subsequent analysis, in concurrence with Ulrich (1943) who suggested that they be sampled.

Effect of deficiency of other elements on the level of nitrogen in the young leaves. Since nitrogen occurs in the leaves mostly in the form of organic compounds like chlorophyll, proteins, and nucleic acids, it is logical to expect the absence of any other component element of those compounds to bring about changes in their quantities. For instance, the chlorophylls are made up of C, H, O, Mg, and N. If magnesium is limiting, the amount of chlorophyll will be affected despite the presence of a liberal amount of nitrogen. Less nitrogen will be present in the form of chlorophyll. If the major part of the nitrogen in the leaves is in the form of chlorophyll, a lower level of nitrogen will result from magnesium deficiency.

This tagging of two elements will not occur, however, if the other element can shift from one form to the other. Referring to the previous example, it is equally possible that whatever nitrogen is not used in the formation of chlorophyll may be present in the form of protein or any simple nitrogenous compound, in which case the nitrogen level will not go down with magnesium deficiency.

Besides getting into the structure of plants, elements have certain physiological roles. Potassium is important in many phases of cell physiology (Sheppard, 1951), magnesium is a catalyst of certain steps in glycolysis (cited by Sumner and Somers, 1947), and molybdenum is necessary in nitrate assimilation (Mulder, 1948). A disturbance in any of these functions may directly or indirectly affect the nitrogen level of the plant.

One of the objects of this experiment was to obtain some idea as to how much allowance to give to the preceding considerations in studies on nitrogen metabolism. Plants were grown for 43 days (June 15 to July 28, 1951) in Espino's best 4-salt solution. Then one lot was transferred to a solution deficient in phosphorus; other lots were transferred to solutions deficient in potassium, calcium, magnesium, and sulfur, as shown in the table on page 226.

Sampling was made 12 days, instead of 7 days, after treatment as in previous experiments, to allow the plants to recover from

whatever abnormality was caused by the typhoon and the thrips [2] and to accentuate the differences due to nutrient deficiency. Plants in the lots deficient in potassium, calcium, and sulfur showed distinct signs of deficiency, whereas those in the lots deficient in phosphorus and magnesium had no marked symptoms of deficiency.

The nitrogen content of the most recently matured leaves of the different lots are shown in table 4. Phosphorus deficiency had the most adverse effect on the nitrogen level. The difference between this lot and the normal plants was significant. Tsao, Rabideau, and Whaley (1950) studied nitrogen absorption in four species of grass in varying states of phosphorus deficiency. They found that in *Andropogon ischaemum* and *Sorghastrum nutans,* phosphorus deficiency lowered nitrogen, but in *Eragrostis trichodes,* it had no effect. In *Boutelua curtipendula,* it consistently increased nitrogen content. Arnon and Hoagland (1943) failed to note any change in the nitrogen level in tomato leaves with the change in phosphorus supply in the medium. They attributed this lack of change to the fact that the medium contained a liberal supply of nitrogen. On the other hand, Nightingale (1942) claimed inverse relationship between phosphorus in the medium and nitrogen absorption. According to Thomas (1945), "the amount of an element absorbed is modified to different degrees not only by the nature of the other elements but also by their relative proportions in the external solution."

DISCUSSION

The following may be the hypothetical scheme of the chain of reactions leading to the production of a crop: the essential nutrient in the soil is absorbed by the plant; the plant translocates the nutrient to the seat of production (the leaves) where it may directly or indirectly influence synthetic activity; the product of synthesis is stored up in the form of a crop.

It will be noted that the nutrient in the soil is at least two steps removed from the crop, whereas the nutrient in the plant is at least one step closer than the soil nutrient to the final product. If the right information can be had, the state of the synthetic activity in the leaves will be a closer guide than the nutrient in the soil to the kind of crop to be expected (Clements, 1940).

There are many factors that can influence synthetic activity, and in order to single out a factor which causes a disturbance in this process, one has to have information about the medium (soil and climate) and how it affects plants metabolism. These considerations all the more emphasize the interdependence of knowledge of the soil, of the climate, and of the physiological activity of the plant.

---

[2] A typhoon occurred on July 30 and the plants had to be taken inside the room to prevent being damaged by strong winds. After two days of diffused light in the room, it was noted that infestation by plant thrips (*Thrips oryzae* Williams—kindly determined by Miss Clare Baltazar of the Department of Entomology) was quite heavy. As a means of control, the thrips were hand-picked and crushed between the fingers.

The present study, in addition to the others performed along this line, promises some integral contribution to the subject of fertilization for increased production. There are, however, many other phases of the work which still have to be studied. For instance, there is not enough information on how late in the life of a plant information from foliar diagnosis can be taken advantage of. Also, we do not know at what percentage of leaf nutrient luxury consumption takes place. These are phases that are being studied by one of the writers.

SUMMARY

1. Elon-elon rice plants of forty-five days of age were grown in two widely divergent media as regards nitrogen.

2. After six days in these media, the different leaves were analyzed for total nitrogen to find which leaf would reflect most the difference in nitrogen level of the media.

3. The nitrogen level of the leaves which had just recently attained maturity seemed to be the best indicator of the nitrogen needs of the plants.

4. Of the major element deficiencies studied, only phosphorus deficiency interfered with nitrogen absorption. However, results of previous investigations are at variance with each other, hence the need for a better-controlled study of the subject.

LITERATURE CITED

ARNON, D. I., AND D. R. HOAGLAND. 1943. Composition of the tomato plant as influenced by nutrient supply in relation to fruiting. Bot Gaz. **104**: 576–590.

A. O. A. C. 1945. Official and tentative methods of analysis. 6th ed., xiii + 932 p. Washington 4, D. C.: Assoc. Off. Agric. Chem.

CABOTAJE, T. G. 1941. Addition of potassium sulfate and superphosphate with ammonium sulfate to Lipa clay loam for upland rice. Philippine Agriculturist **30**: 136–141.

CLEMENTS, H. F. 1940. Integration of climatic and physiological factors with reference to the production of sugar cane. The Hawaiian Planters Record **44**: 201–233.

ENRILE, P. C. 1938. Should potassium sulfate be added with ammonium sulfate to Lipa clay loam for upland rice? Philippine Agriculturist **27**: 148–167.

ESPINO, R. B. 1920. Some aspects of the salt requirements of young rice plants. Philippine Agriculturist **16**: 455–525.

GALVEZ, N. L. 1936. Plant-food reserve in lowland and upland soils. Philippine Agriculturist **25**: 221–232.

MACASAET, M. S. 1935. A study of the N–P_2O_5–K_2O ratio for an upland rice (Inintiw) when grown in tuff soil in pots. Philippine Agriculturist **24**: 678–699.

MITRA, A. K., AND P. S. GUPTA. 1950. Paddy manuring and its economics in Uttar Pradesh. Indian Farming **11** (7): 295–297.

MULDER, E. G. 1948. Importance of molybdenum in the nitrogen metabolism of micro-organism and higher plants. Plant and Soil **1**: 94.

NIGHTINGALE, G. T. 1942. Potassium and phosphate nitrogen of pineapple in relation to nitrate and carbohydrate reserve. Bot. Gaz. **104**: 191–223.

SHEPPARD, C. W. 1951. New development in potassium and cell physiology. 1940–1950. Science **114**: 55–90.

SUMNER, J. B., AND G. F. SOMERS. 1947. Chemistry and methods of enzymes. 2nd ed. New York: Academic Press.

TALAMISAN, B. G. 1938. Should superphosphate be added with ammonium sulfate to Lipa clay loam for upland rice? Philippine Agriculturist **27**: 284–301.

THOMAS, W. 1937. Foliar diagnosis. Principles and practice. Plant Physiology **12**: 571–600.

————. 1945. Present status of diagnosis of mineral requirements of plants by means of leaf analysis. Soil Science **59**: 353.

TOPACIO, D. 1938. Determination of the fertilizers and fertilizer mixture suitable for an upland rice. Philippine Agriculturist **27**: 471–494.

TRELEASE, S. F. 1920. The growth of rice as related to proportions of fertilizer salts added to soil cultures. Philippine Jour. Sci. **16**: 603–637.

————, AND M. C. JURADO. 1920. The growth of rice as related to concentrations and properties of fertilizer salts added to soil cultures. Philippine Agriculturist **9**: 67–86.

TSAO, T., G. S. RABIDEAU, AND W. G. WHALEY. 1950. Effects of differences in phosphorus nutrition on the nitrogen content and phosphorus—32 absorption of four species of grass. Bot. Gaz. **112**: 214–221.

ULRICH, A. 1943. Plant analysis as a diagnostic procedure. Soil Science **55**: 101–112.

YNALVEZ, L. A. 1938. Note: A method of adding alkali in Kjeldahl distillation. Philippine Agriculturist **26**: 823–826.

TABLE 1

Percentage of moisture (fresh-weight basis) in different leaves of young rice plants grown in unfertilized soil and in soil fertilized with ammonium sulfate

SAMPLE	REPLICATION			
	I	II	III	Mean
Fertilized:				
Leaf No. 1 (youngest) ..	71.5	71.8	72.0	71.8
" " 2	72.7	71.4	71.3	71.8
" " 4 (oldest)	59.8	68.9	67.5	65.4
Unfertilized:				
Leaf No. 1 (youngest) ..	71.0	71.0	72.3	71.4
" " 2	68.9	72.5	71.8	71.1
" " 4 (oldest)	66.8	67.3	66.2	66.8

TABLE 2

Percentage of total nitrogen (dry-weight basis) in the different leaves of young rice plants grown in unfertilized soil and in soil fertilized with ammonium sulfate [a]

SAMPLE	REPLICATION			
	I	II	III	Mean
Fertilized:				
Leaf No. 1 (youngest) ..	5.44	4.63	4.56	4.88
" " 2	4.96	5.14	5.22	5.11
" " 4 (oldest)	2.96	2.77	3.40	3.04
Unfertilized:				
Leaf No. 1 (youngest) ..	3.80	4.55	3.70	4.02
" " 2	3.68	4.53	3.44	3.88
" " 4 (oldest)	2.08	2.43	2.40	2.30

L.S.M.D. = 0.72

[a] Planted January 10, 1951; fertilized February 24, 1951; sampled March 2, 1951.

TABLE 3a

Percentage of total nitrogen (dry-weight basis) in the different leaves of young rice plants in complete and nitrogen-deficient solutions [a]

SAMPLE	REPLICATION			
	I	II	III	Mean
Complete:				
Leaf No. 1	6.55	6.70	6.62	6.62
" " 5	5.76	5.31	5.56	5.54
Nitrogen-deficient:				
Leaf No. 1	5.67	5.46	5.07	5.40
" " 5	5.59	5.66	5.54	5.60

L.S.M.D. = 0.42

[a] Planted February 9, 1951; treated April 4, 1951; sampled April 7, 1951.

TABLE 3b

Percentage of total nitrogen (dry-weight basis) in the different leaves of young rice plants in complete and nitrogen-deficient solutions [a]

SAMPLE	REPLICATION			
	I	II	III	Mean
Complete:				
Leaf No. 1	6.62	6.65	6.56	6.61
" " 2	6.30	6.68	6.30	6.43
" " 3	5.56	6.27	5.59	5.81
" " 4	5.36	5.58	5.17	5.37
" " 5	4.87	5.46	5.55	5.29
Nitrogen-deficient:				
Leaf No. 1	4.39	4.20	3.94	4.18
" " 2	3.77	4.27	4.43	4.16
" " 3	4.82	4.72	4.75	4.43
" " 4	3.57	4.21	4.33	4.04
" " 5	3.18	3.16	3.33	3.22

L.S.M.D. = 1.75

[a] Planted February 9, 1951; treated April 4, 1951; sampled April 10, 1951.

TABLE 4

Percentage of total nitrogen (dry-weight basis) in the youngest fully developed leaves of plants suffering from different nutrient deficiencies [a]

SAMPLE	REPLICATION			
	I	II	III	Average
Complete solution	5.23	5.49	5.57	5.43
Phosphorus-deficient	4.82	4.39	4.71	4.64
Potassium-deficient	5.25	4.37	5.01	4.88
Calcium-deficient	5.35	5.56	5.10	5.34
Magnesium-deficient	4.45	5.40	4.79	4.88
Sulfur-deficient	4.48	5.24	4.90	4.87

L.S.M.D. = 0.61

[a] Planted June 15, 1951; treated July 28, 1951; sampled August 9, 1951.

THE INFLUENCE ON RED GLOBE ONION OF DIFFERENT AMOUNTS OF SURFACE AND SUBSURFACE IRRIGATION WATER [1]

ANDRES P. AGLIBUT AND FRANK L. TACLAY

WITH FOUR TEXT FIGURES

The amount of water most effective in surface and subsurface irrigations is of great importance in the culture of Red Globe onion. The effects of the two methods of irrigation on the growth and yield of a crop were studied in the experimental plots behind the Agricultural Botany building, and the data were analyzed in the Department of Agricultural Engineering from November, 1949, to March, 1951.

MATERIALS AND METHODS

Red Globe onion from the Department of Agriculture and Natural Resources was used in the study. This variety is commonly raised by local farmers. It is resistant to pests and diseases, is medium-maturing, and has a relatively good keeping quality.

Eighty 5-gallon kerosene cans were cut crosswise, uniformly perforated at the bottom, and tar-painted for use as pots. Twenty 55-gallon gasoline drums were cut lengthwise and tarred to serve as troughs for the containers. The troughs were placed on five platforms made of tarred lumber.

The volume of water contained by a mason jar was determined so that the different amounts of water applied in each treatment could be measured . A No. 10 perforated tin can was used to sprinkle water on the surface-irrigated plants.

The diameters of the stalks and bulbs of the onion plants were measured weekly with a Vernier caliper. The weight of the bulbs at harvest was taken on a Cenco balance.

For soil medium, Los Baños clay loam medium phase was gathered from four places, thoroughly mixed, and pulverized. The resulting soil mixture was reddish-brown; it easily crumbled when dry but was sticky and plastic when wet. The pulverized soil was sifted through a 7-mm. sieve. Its moisture content was determined in the Soils Department, and its water-holding capacity of 54.22 per cent on the air-dry basis, or 62.85 per cent on the oven-dry basis, was determined in the Department of Agricultural Botany.

---

[1] Central Experiment Contribution No. 1622. From the thesis presented by the junior author for graduation, April, 1951, with the degree of Bachelor of Science in Agriculture from the College of Agriculture.

In each of the two plantings, 80 containers with 9.6 kg. of soil each were used. In 40 of these containers, seedlings were grown to 34 days old for the first planting and to 36 days old for the second planting. As soon as the seedlings were established, they were thinned to five plants to each can. The rest of the seedlings were transplanted in the other 40 cans, five to each pot. The first set of 40 cans were divided at random into two lots which were designated lot I for surface irrigation and lot III for subsurface irrigation. The second set of 40 cans containing the transplanted thinnings were similarly divided into two lots which were designated lot II for surface irrigation and lot IV for subsurface irrigation. Each of the four lots was further subdivided at random into five culture treatments of four cans each, or a total of 20 plants to a treatment as shown in the plan below:

Plan of Experiment

PLANTING	LOT	METHOD OF PLANTING	MODE OF IRRIGATION	AMOUNT OF WATER IN LITERS ADDED EVERY THREE DAYS [a]				
				1	*2*	*3*	*4*	*5*
First	I	Not transplanted	Surface	0.78	1.56	2.34	3.12	3.90
	II	Transplanted	Surface	"	"	"	"	"
	III	Not transplanted	Subsurface	"	"	"	"	"
	IV	Transplanted	Subsurface	"	"	"	"	"
Second	I	Not transplanted	Surface	0.52	0.78	1.56	2.34	3.12
	II	Transplanted	Surface	"	"	"	"	"
	III	Not transplanted	Subsurface	"	"	"	"	"
	IV	Transplanted	Subsurface	"	"	"	"	"

[a] Water was not added whenever the rainfall on the day previous to the scheduled day of application exceeded 1.5 millimeters.

Fine weather prevailed during the growing period of the second planting so that the cans were left outdoors. The seedlings in both plantings were watered regularly until their stems were 3 to 4 millimeters in diameter, at which time they were thinned. The seedlings, transplanted and not transplanted, were uniformly watered daily for 21 days.

Based on the weight and the water-holding capacity of the soil, the amount of water added twice a week to every can in each treatment for the surface and subsurface irrigations were: 10 per cent, or 0.52 liter; 15 per cent, or 0.78 liter; 30 per cent, or 1.56 liters; 45 per cent, or 2.34 liters; 60 per cent, or 3.12 liters; and 75 per cent, or 3.90 liters. The water for surface irrigation was measured with calibrated mason jars and sprinkled with the painted and perforated tin can. The measured amounts of water for the subsurface-irrigated plants were poured in the respective half-drum troughs after the water level had been raised to the datum mark.

The mature bulbs were harvested with a hand trowel with as many of their roots as possible, washed, dried, weighed, and measured with a caliper.

RESULTS AND DISCUSSION

First planting

The retarded growth of the transplanted plants during the first three weeks of surface and subsurface irrigations is shown in figure 1. The surface-irrigated plants in lots I and II exhibited better stand than the subsurface-irrigated plants in lots III and IV. Transplanted and not transplanted plants given surface irrigations of 15 and 30 per cent and subsurface irrigation of 15 per cent exhibited the best stand three weeks after the start of the treatments.

The diameter of the stalks were measured weekly for the twelve weeks of the irrigation treatments (table 1a). The appearance of the plants one week before measuring may be seen in figure 1. The plants in lot I showed consistent but not uniform stem growth until the tenth week of treatments 1 and 2 and the ninth week of treatments 3, 4, and 5. After these periods, stem growth ceased. The weekly average total growth was greatest in the seedlings not transplanted and surface-irrigated with water equivalent to 15 per cent of the water-holding capacity of the soil.

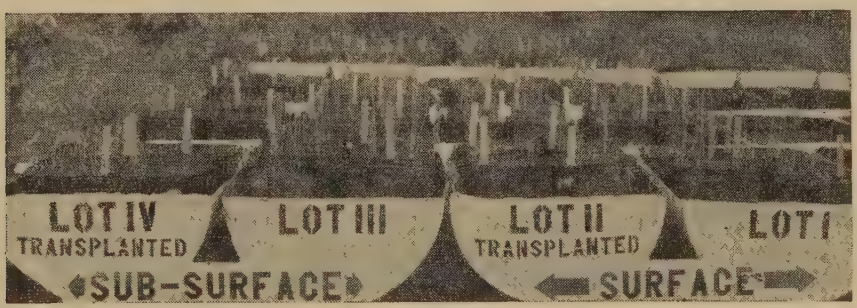

Fig. 1.—The appearance 54 days after seeding and 20 days after transplanting of onion plants of the first planting treated with different amounts of water. In each lot, 5 cultures given 15, 30, 45, 60, and 75 per cent of the water-holding capacity of the soil are represented.

Among the transplanted and surface-irrigated plants of lot II, the greatest total growth was observed in those irrigated with 30 per cent. The plants in this lot began dying on the fifth week.

In the first treatment of lot III, stem development continued up to the tenth week, the period of greatest growth. The plants given heavier irrigation stopped growing on the ninth week after a rather slow development.

The transplanted subsurface-irrigated seedlings (lot IV) had an unequal stem development. As in the other lots, stem growth stopped either on the ninth or the tenth week of growth. The plants which received lighter irrigation exhibited better stalk growth.

Table 2a shows the development of the onion bulbs. One week after transplanting, the seedlings which were not transplanted and given surface and subsurface irrigations (lots I and III) had higher average initial sizes of bulbs than the transplanted seedlings of corresponding treatments (lots II and IV). This shows the retarding effect of transplanting on the growth of onion bulbs.

The seedlings did not develop uniform bulbs. Surface irrigation gave a greater average increase in size of bulb than subsurface irrigation, and the lighter surface irrigations gave the greatest increase of all. The average weekly increase in size of bulb in treatment 1 of lot I was 0.143 centimeter, and in treatment 2 of the same lot, 0.114 centimeter. The heavier surface irrigations not only produced less developed bulbs but also caused apparently greater susceptibility to root and stem rot (table 4a).

Subsurface irrigation of lot III did not give as good a development of bulbs as surface irrigation. Table 4a shows the number of dead plants in the different treatments. Many of the heavier-irrigated plants died, and none which received lighter irrigation reached maturity. Some of the plants died as early as the sixth week of observation.

Among the transplanted seedlings, those that were surface-irrigated (lot II) showed better bulb development than the subsurface-irrigated cultures. More of the plants given lighter surface irrigation reached the fourteenth week of observation than those given heavier applications. The greatest increase in size of bulb of 0.017 centimeter a week was observed in the second treatment which received 30 per cent irrigation. None of the plants died. The next greatest increase in size was .015 centimeter attained each week by treatment 1. One death was noted on the fourteenth week.

Subsurface irrigation of transplanted onion seedlings (lot IV) produced slow and variable bulb growth and apparently caused greater susceptibility to disease. The continuous supply of ample moisture from the 15 per cent subsurface irrigation produced the best bulb growth. In all the treatments, deaths from diseases took place on the sixth week of observation. Figure 3 shows the relative sizes of the bulbs of the plants at harvest time.

The yield of bulbs from the first planting may be seen in table 3a. The yield from the plants not transplanted and surface-irrigated (lot I) showed a consistently greater mean weight for each can in all the five treatments than the yield from the subsurface-irrigated plants (lot III) in the corresponding treatments. The greatest mean yield of 106.70 grams for each can was obtained from the plants surface-irrigated with 1.56 liters of water, followed closely by 103.55 grams from those more lightly irrigated with 0.78 liter. Among the subsurface-irrigated plants, the greatest mean weight of 78.48 grams a can was observed in the 0.78 liter treatment. The mean yields

from the plants treated with heavier subsurface irrigations were very much lower on account of the fewer plants that survived.

Among the seedlings that were transplanted and surface-irrigated (lot II), the greatest mean yield of a can was 90.60 grams noted in the 1.56 liter treatment and 80.80 grams in the 0.78 liter treatment. The mean yields from the cans given higher surface irrigations were very much lower. In the first treatment of the subsurface-irrigated transplanted seedlings (lot IV), the highest mean yield was 84.45 grams, and in the second, 43.60 grams. As in the other subsurface-irrigated lot (lot III), the mean yield was greater from those given lighter irrigations than from those given heavier irrigations.

The different cultures showed unusually different degrees of resistance to pests and diseases. The onion plants which were irrigated more heavily were more susceptible to pests and diseases. Table 4a records weekly the number of living plants in every treatment of all lots. The seedlings not transplanted and given lighter surface and subsurface irrigations (treatments 1 and 2 of lots I and II) were least affected by onion rot, *Sclerotium rolfsii* Sacc, which attacked the roots and stems of the plants as early as the sixth week of observation. This disease caused about 30 per cent of destruction. Cut worm, *Prodenia litura* Fabricious,[2] attacked the leaves of some plants but were controlled by hand-picking. The highest destruction of 30 per cent occurred in treatments 2, 4, and 5 of lot III and treatment 3 of lot II. The percentages of destruction by lots were: lot I, 25; lot II, 85; lot III, 110; and lot IV, 55.

The weather record (table 5) during the period was taken in the local weather observation station, the rain gauge of which was about 10 meters from the cultures. The total precipitation for 72 days, from November 15, 1949, to April 22, 1950, was 41.06 centimeters. The heaviest precipitation of 15.00 centimeters occurred in December, 1949. The average temperatures were 22.92°C. minimum and 29.60°C. maximum.

The different rates of application of surface and subsurface irrigations in the two plantings are shown in table 6. Among the transplanted seedlings, surface irrigation produced a higher average weekly growth in stalk diameter than subsurface irrigation in the corresponding five rates of application. Lighter surface irrigations of 32.50 ha. cm. and 65.00 ha. cm. applied in 24 irrigations, besides the 41.06 cm. of rainfall which fell in 72 days, produced better stalk growth than heavier surface applications. With the seedlings not transplanted, surface irrigation again gave better stalk growth than subsurface irrigation in all the corresponding rates of application. Lighter surface irrigations of 32.50 ha. cm. and 65.00 ha. cm. applied in 24 days, besides the rainfall for the period, gave better stalk growth than heavier surface irrigations.

---

[2] The pest was identified in the Department of Entomology.

The influence of the different rates of surface and subsurface irrigations on the growth of bulbs of transplanted seedlings are shown in table 2a. Again, surface irrigations of 65.00 ha. cm., 97.50 ha. cm., and 130.00 ha. cm. of water, besides the rainfall for the period, gave better bulb growth than subsurface irrigation. Surface and subsurface irrigations of 32.50 ha. cm., in addition to 41.06 centimeters of rain, gave almost the same bulb growth.

With the seedlings not transplanted, surface irrigation gave better growth of bulbs than subsurface irrigation in four of the five treatments. Subsurface irrigation of 32.50 ha. cm. of water, besides the rainfall for the period, produced better bulb growth than any of the other subsurface applications. The best rate of application for bulb growth of seedlings not transplanted was from 52.50 to 65.00 ha. cm. for surface irrigation and 32.50 ha. cm. for subsurface irrigation.

Fig. 2.—The appearance 57 days after seeding and 21 days after transplanting of onion plants of the second planting treated with different amounts of water. In each lot, 5 cultures given 10, 15, 30, 45, and 60 per cent of the water-holding capacity of the soil are represented.

A comparison of the two methods of irrigation based on the yield of bulbs shows that among the transplanted seedlings, the highest mean weight of bulb was obtained from those surface-irrigated with 65.00 ha. cm. and 32.50 ha. cm. and those subsurface-irrigated with 32.50 ha. cm. (table 3a). Similarly, among the seedlings not transplanted, surface irrigations of 65.00 ha. cm. and 32.50 ha. cm. gave the best yields. Subsurface irrigation of 32.50 ha. cm. produced very much less yield than surface irrigation of the same rate.

The influence on plant death of the different amounts of irrigation water applied by the two methods is shown in table 4a. Fewer plants died in the cultures which were surface-irrigated with 32.50 ha. cm. and 65.00 ha. cm. (15 and 30 per cent) than in those subsurface-irrigated with the same amounts. Curry [3] got the best yield

[3] Curry, A. S. 1941. Effect of irrigation practices on the growth and yield of White Grano onions. New Mexico College of Agriculture and Mechanical Arts Agric. Exper. Sta. Bull. 281.

of onions under New Mexico conditions with 30.85 ha. cm. The result of the present study points to 32.50 to 65.00 ha. cm. as the best range, which agrees with the finding of Curry.

Second planting

The retarding effect of transplanting was shown by the onion plants for two weeks (fig. 2). Among the transplanted seedlings, those given less subsurface irrigation (treatment 1 of lot IV, 0.52 liter; treatment 2, 0.78 liter; and treatment 3, 1.56 liters) showed better stand than those given heavier surface irrigations and subsurface irrigations of 2.34 and 3.12 liters.

Among the seedlings which were not transplanted, those subsurface-irrigated with 0.52 to 1.56 liters a can, approximately equivalent to 10 to 30 per cent of the water-holding capacity of the soil (treatments 1, 2, and 3, lot III), showed better stand and growth than those surface-irrigated and subsurface-irrigated with the same or greater amount of water. Similarly, the seedlings given lighter surface irrigations (treatments 1, 2, and 3 of lot I) grew and developed better than those given heavier irrigations (treatments 4 and 5 of the same lot). In general, the transplanted plants showed poorer stand than the plants not transplanted in the corresponding lots and treatments.

Fig. 3.—The appearance 159 days after seeding and 125 days after transplanting of onion plants represented in fig. 1. To the left is a part of the second planting.

The diameters of the stems were measured weekly for six weeks after the first week of irrigation treatments (table 1b). The seedlings not transplanted and given surface and subsurface irrigations (lots I and III) had greater initial average total diameter than the transplanted seedlings (lots II and IV). The plants had greater initial stalk diameters than those of the first planting of the same

ages. Also, they grew and developed fast. Most of them ceased to grow three weeks after transplanting. The absence of heavy rains, the cool nights, and the fairly warm days seemed to accelerate the growth and maturity of the plants.

The seedlings not transplanted showed a greater increase in stalk diameter when surface-irrigated with 30 per cent and 45 per cent of the water-holding capacity of the soil than when subsurface-irrigated with the same amounts (treatments 2, 3, and 4 of lot I and the corresponding treatments in lot III). However, lighter subsurface irrigation produced more stem growth than surface irrigation in seedlings not transplanted (fig. 3).

Among the transplanted seedlings, heavier surface irrigations produced greater growth of stem than subsurface irrigations (treatments 3, 4, and 5, lot II, and the corresponding treatments in lot IV). Conversely, lighter subsurface irrigations (treatments 1 and 2, lot IV) gave more stem growth than corresponding amounts of surface irrigation (treatments 1 and 2, lot II). These conclusions are based on the measurements from the first to the third week after transplanting.

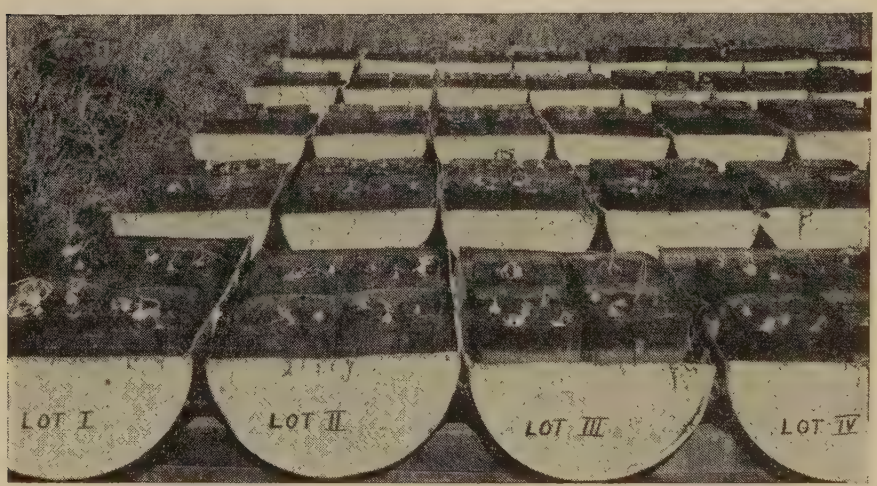

Fig. 4.—The appearance 128 days after seeding and 94 days after transplanting of onion plants represented in fig. 2. To the right are cans used in the first planting but not in the second planting.

The average diameter of the bulbs (table 2b) measured weekly after the second week of irrigation was greater in the seedlings not transplanted (lots I and III) than in the transplanted ones (lots II and IV). The rate of increase was greater in the second planting than in the first.

Table 3b shows the yield and figure 4 the relative size of bulbs of the onion plants in the second planting. With the seedlings that

were not transplanted, subsurface irrigation with 10 per cent of the water-holding capacity of the soil gave the greatest mean yield in each can, followed closely by subsurface irrigation with 15 per cent. While light subsurface irrigations gave better mean yield than light surface irrigations, heavy surface irrigations gave better yield than heavy subsurface irrigations.

With the transplanted seedlings, light subsurface irrigations gave higher mean yield than heavy subsurface irrigations and light or heavy surface irrigations. Heavy surface irrigations, however, produced bigger mean yield of bulbs than heavy subsurface irrigations.

As in the first planting, there was unusual variation in resistance among the cultures (table 4b). The plants irrigated with greater amounts of water were more susceptible to plant diseases. The plants of lot I (not transplanted) which were given lighter surface irrigations (treatments 1 and 2) were least affected by *Sclerotium rolfsii*. Cut worm attacked the leaves of some plants given lighter surface or subsurface irrigation. Besides the onion rot and cut worm, a species of *Thrips* [4] also attacked the leaves. This pest was controlled by using tartar emetic spray.[5]

Table 5 records the total precipitation and the minimum and maximum temperatures during the second planting.

The period of observation in the second planting was shorter than in the first planting. With the transplanted seedlings, heavy surface irrigations of 40.63 ha. cm., 60.94 ha. cm., and 81.25 ha. cm. produced better stalk diameter than the corresponding subsurface applications. The lighter subsurface irrigations of 13.54 and 20.31 ha. cm. produced greater stalk diameter than surface irrigations of the same amounts. Heavier surface irrigations, however, produced larger stalks than equivalent subsurface irrigations.

The growth of the bulbs in nine weeks, three weeks longer than the growth of the stalks, showed that among the transplanted seedlings, those which were surface-irrigated with 40.63, 60.94, and 81.25 ha. cm. produced better growth of bulb than those correspondingly subsurface-irrigated. Lighter subsurface irrigations of 13.54 ha. cm. and 20.31 ha. cm. gave better growth of bulb than the corresponding amounts of surface irrigation. The highest average weekly increase in bulb diameter of the transplanted seedlings was obtained from the 20.31 ha. cm. (15 per cent) surface irrigation, which was almost equal to that of the 13.54 ha. cm. (10 per cent) subsurface irrigation.

As to yield of bulbs, the transplanted seedlings subsurface-irrigated with 10 per cent of the water-holding capacity of the soil gave 122.58 grams, and those subsurface-irrigated with 15 per cent, 104.45 grams. Heavier amounts of surface irrigations produced correspondingly more yield in transplanted seedlings than subsurface

[4] The pest was identified in the Department of Entomology.

[5] The spray was recommended by Dr. G. B. Viado of the Department of Entomology.

irrigations. Seedlings not transplanted and given lighter subsurface irrigations of 0.52 liter (10 per cent) and 0.78 liter (15 per cent) produced greater yields than those given heavier subsurface irrigations. Surface irrigations of 30, 45, and 60 per cent of the water-holding capacity of the soil gave better mean yield of bulbs than the corresponding subsurface irrigations.

Table 4b shows the influence of the different amounts of surface and subsurface irrigations on the mortality of the seedlings. There was no death among the transplanted plants irrigated with 10 per cent of the water-holding capacity of the soil in both surface and subsurface irrigations. With the seedlings not transplanted, more deaths occurred among those given subsurface and heavier surface irrigations. There was no death among the plants which were surface-irrigated with 0.52 and 0.78 liter.

SUMMARY

1. Surface irrigation of 15 to 30 per cent of the water-holding capacity of the soil, air-dry basis, and subsurface irrigation of 10 to 15 per cent produced the best growth in diameter of stem and bulb of Red Globe onion.

2. The yield of the surface-irrigated plants decreased when either less than 15 per cent or more than 30 per cent of water was applied to each can in one application. When the plants were subsurface-irrigated, however, the yield decreased when the water exceeded 15 per cent.

3. The moderately higher temperature, lower humidity, slightly longer days, and less rainfall in the second planting than in the first apparently accelerated the growth and maturity of the bulbs.

4. The mortality of onion plants due to root and stem rots increased with increasing amounts of water in surface and subsurface irrigations in the dry and rainy seasons.

5. In the first or rainy-season crop, the highest yield of 30 per cent obtained from the plants not transplanted and given surface irrigation was higher than that obtained from the transplanted plants given subsurface irrigation of 15 per cent. In the second or dry-season crop, subsurface irrigation even in small amounts was definitely superior to surface irrigation.

TABLE 1a

Average weekly total stalk diameter of the first planting of transplanted and not transplanted onion seedlings grown in unfertilized Los Baños clay loam and given surface and subsurface irrigations [a]

MOISTURE			AGE OF PLANTS IN DAYS										
			61	68	75	82	89	96	103	110	117	124	131	138
liters	*ha. cm.*		*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
						LOT I—SEEDLINGS NOT TRANSPLANTED, SURFACE-IRRIGATED								
0.78	32.50		2.58	2.79	3.00	3.23	3.32	3.45	4.37	4.45	4.46	4.77	4.79	4.41
1.56	65.00		2.46	2.69	2.90	3.18	3.42	3.64	4.02	4.08	4.25	4.43 [b]	4.18	3.84
2.34	97.50		2.46	2.63	2.81	3.04	3.31	3.64	3.86	3.93	4.09	3.81	3.41	3.12
3.12	130.00		2.51	2.70	2.94	3.18	3.29	3.61	3.73	3.84	4.05	3.89	3.62	3.42
3.90	162.50		2.65	2.83	3.00	3.16	3.35	3.54	3.63	3.71	3.93	3.73	3.49	3.00
						LOT II—SEEDLINGS TRANSPLANTED, SURFACE-IRRIGATED								
0.78	32.50		1.63	1.86	2.16	2.40	2.71	2.73	3.49	3.79	3.76	3.79	3.82	3.45
1.56	65.00		1.70	2.02	2.44	2.86	3.18	3.34	3.57	3.87	4.16	4.26	4.04	3.81
2.34	97.50		1.83	1.99	2.33	2.55	2.86 [b]	3.04	2.84	3.14	3.39	3.36	2.97	2.58
3.12	130.00		1.90	2.06	2.39	2.53	2.89	3.10	2.99	3.28	3.37	3.35	3.04	2.80
3.90	162.50		1.65	1.86	2.11	2.31	2.51	2.74 [b]	2.68	2.86	3.04	2.94	2.73	2.33
						LOT III—SEEDLINGS NOT TRANSPLANTED, SUBSURFACE-IRRIGATED								
0.78	32.50		2.76	2.94	3.13	3.34	3.48	3.60	3.65	3.78	4.14	4.16	3.85	3.31
1.56	65.00		2.28	2.34	2.43	2.58	2.76	2.90	2.51	2.63	2.82	2.71	2.36	2.05
2.34	97.50		2.11	2.25	2.52	2.66	2.85	3.06	3.16	3.21	3.58	3.12	3.03	2.79
3.12	130.00		2.21	2.35	2.52	2.72	2.99	3.08	2.75	2.81	2.59	2.30	2.19	2.07
3.90	162.50		2.10	2.26	2.39	2.54	2.64	2.66 [b]	2.79	2.82	3.13	2.94	2.62	2.36 [c]
						LOT IV—SEEDLINGS TRANSPLANTED, SUBSURFACE-IRRIGATED								
0.78	32.50		1.89	2.18	2.44	2.78	2.78	3.05	3.30	3.46	3.61	3.63	3.42	3.11
1.56	65.00		1.65	1.75	1.89	2.05	2.23	2.41 [b]	2.62	2.74	2.89	2.81	2.85	2.75
2.34	97.50		1.85	2.02	2.20	2.31	2.42	2.52 [b]	2.46	2.64	2.75	2.83	2.79	2.75
3.12	130.00		1.79	1.88	1.98	1.99	2.32	2.42 [d]	2.14	2.29	2.44	2.51	2.54	2.16
3.80	162.50		1.46	1.48	1.75	1.90	2.08	2.09 [b]	2.35	2.44	2.62	2.71	2.67	2.52

[a] Unless otherwise specified in footnotes *b* to *d*, the frequencies of the means correspond to those of table 4a.
[b] One plant without stalk.
[c] Two plants without stalks.
[d] Three plants without stalks.

TABLE 1b

Average weekly total stalk diameter of the second planting of transplanted and not transplanted onion seedlings grown in unfertilized Los Baños clay loam and given surface and subsurface irrigations [a]

MOISTURE			AGE OF PLANTS IN DAYS					
			64	71	78	85	92	99
liters	*ha. cm.*		*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
			LOT I—SEEDLINGS NOT TRANSPLANTED, SURFACE-IRRIGATED					
0.52	13.54		4.28	4.42	4.58	3.64	3.59	3.14
0.78	20.31		4.00	4.61	4.98	3.76	3.66	3.38
1.56	40.63		4.06	4.83	5.48	4.05 [b]	3.54	3.42
2.34	60.94		4.25	4.86	5.26	4.02	3.10	3.34
3.12	81.25		3.35	3.66 [b]	3.83	3.22	3.04	3.09
			LOT II—SEEDLINGS TRANSPLANTED, SURFACE-IRRIGATED					
0.52	13.54		3.30	3.73	3.54	3.44	3.25	2.88
0.78	20.31		3.20	3.92	3.88	3.71 [b]	3.55	3.14
1.56	40.63		3.41	4.37	4.49	4.28	4.07	3.40 [b]
2.34	60.94		3.76	4.44	4.45	4.05	3.83	3.02
3.12	81.25		3.66	4.41	4.51	3.64	3.38	2.50 [b]
			LOT III—SEEDLINGS NOT TRANSPLANTED, SUBSURFACE-IRRIGATED					
0.52	13.54		4.36	4.82	5.04	4.54	4.32	4.10 [b]
0.78	20.31		4.22	4.92	4.99	3.79 [b]	3.79	3.09
1.56	40.63		3.85	4.26	3.99	3.72	2.91	2.92
2.34	60.94		3.60	3.83	3.90	3.34	3.52	2.49 [b]
3.12	81.25		3.72	3.90	3.48	3.06	2.89	2.24 [b]
			LOT IV—SEEDLINGS TRANSPLANTED, SUBSURFACE-IRRIGATED					
0.52	13.54		3.28	4.22	4.45	4.79	4.55	4.10
0.78	20.31		3.37	4.67	4.76	4.16	4.46	3 73
1.56	40.63		3.56	4.24	4.31	4.28	4.15	3.47
2.34	60.94		3.36	3.77	3.86	3.06 [b]	2.90	1.76
3.12	81.25		3.39	3.90	3.88	3.51	3.39	1.96

[a] Unless otherwise specified in footnote *b*, the frequencies of the means correspond to those of table 4b.

[b] One plant without stalk.

TABLE 2a

Average weekly total bulb diameter of the first planting of transplanted and not transplanted onion seedlings grown in unfertilized Los Baños clay loam and given surface and subsurface irrigations [a]

MOISTURE			AGE OF PLANTS IN DAYS												
			68	75	82	89	96	103	110	117	124	131	138	145	152	
liters	*ha. cm.*		*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	
			LOT I—SEEDLINGS NOT TRANSPLANTED, SURFACE-IRRIGATED												
0.78	32.50		6.48	6.81	7.38	7.91	7.15	9.18	10.69	12.43	13.67	14.80	15.09	16.41	16.16	16.49
1.56	65.00		6.93	7.18	7.55	8.15	8.88	9.96	10.82	12.14	12.99	13.79	13.94	14.69	15.01	14.88
2.34	97.50		7.08	7.20	7.46	7.91	8.63	9.85	11.37	11.29	12.99	12.06	12.23	12 96	12.55	12.45
3.12	130.00		6.65	6.78	7.04	7.49	8.19	9.14	9.47	10.63	10.40	12.03	12.28	12.63	12.88	12.81
3.90	162.50		5.90	6.09	6.50	7.20	8.25	9.52	10.06	10.60	11.25	12.89	12.95	13.00	11.89	11.19
			LOT II—SEEDLINGS TRANSPLANTED, SURFACE-IRRIGATED												
0.78	32.50		4.03	4.20	4.58	5.20	6.14	7.44	8.56	10.31	10.81	13.09	13.22	13.47	14.35	14.36
1.56	65.00		3.55	3.75	4.21	4.86	6.16	7.56	8.76	10.75	11 03	13.23	14.34	14.17	15.06	15.16
2.34	97.50		3.83	4.03	4.46	5.18	6.11	5.99	7.25	8.44	8.77	10.61	10.20	10.59	10.23	10 25
3.12	130.00		3.64	3.84	4.28	5.15	6.25	7.39	6.39	8.46	8.90	10.44	10.31	10.07	10.04	9.88
3.90	162.50		3.73	3.94	4.19	4.63	5.70	5.86	7.09	8.02	7.93	7.38	8.88	9.17	9.44	8.77
			LOT III—SEEDLINGS NOT TRANSPLANTED, SUBSURFACE-IRRIGATED												
0.78	32.50		6.45	6.63	6.98	7.55	8.45	9.75	10.33	11.01	11.27	12.54	11.79	12.16	12.99	13.10
1.56	65.00		5.59	5.76	6.13	6.74	7.68	7.11	7.69	8.19	8.23	8.31	8.29	8 39	8.39	8.21
2.34	97.50		5.95	6.10	6.41	6.91	7.79	8.47	9.41	9.89	9 32	8.94	9.03	9.76	9.82	9.84
3.12	130.00		5.39	5.60	5.90	6.40	7.20	7.35	7.56	6.86	6 98	6.96	7.44	7.99	8.05	8.05
3.90	162.50		5.23	5.35	5.61	6.01	6 63	7.39	8.13	8.84	8.77	8.94	7.94	7.39	7.88	7.63
			LOT IV—SEEDLINGS TRANSPLANTED, SUBSURFACE-IRRIGATED												
0.78	32 50		3.45	3.74	4.34	5.30	6.66	7.69	8.01	9.41	9.79	12.34	12.36	12.76	13.59	14.04
1.56	65.00		3.78	4.05	4.40	4.94	5.68	6.04	6.57	7.03	7.22	7.91	8.09	8 28	9.81	9.89
2.34	97.50		3.74	3.89	4.14	4.65	5.35	5.55	5.39	6.59	6.72	7.67	7.79	8.02	9.00	9.48
3.12	130.00		3.09	3.25	3.64	4.19	5.09	5.13	5.11	6.38	6.61	5.53	7.18	6.99	8 08	8.14
3.90	162.50		2.56	2.75	3.11	3.71	4.50	5.37	5.50	6.52	6.76	6.95	7.10	7.66	8.87	9.08

[a] Corresponding frequencies of these figures are found in table 4a.

TABLE 2b

Average weekly total bulb diameter of the second planting of transplanted and not transplanted onion seedlings grown in unfertilized Los Baños clay loam and given surface and subsurface irrigations [a]

MOISTURE		AGE OF PLANTS IN DAYS								
		71	78	85	92	99	106	113	120	127
liters	*ha. cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
		LOT I—SEEDLINGS NOT TRANSPLANTED, SURFACE-IRRIGATED								
0.52	13.54	8.18	9.06	11.28	11.29	11.83	11.38	13.45	13.24	13.27
0.78	20.31	8.47	9.64	13.38	13.76	13.92	13.94	16.93	17.08	16.50
1.56	40.63	9.56	10.55	12.98	13.45	14.02	14.13	14.74	15.27	14.35
2.34	60.94	9.35	10.99	14.48	15.43	15.99	16.18	16.34	16.23	15.26
3.12	81.25	7.35	8.44	11.64	12.27	12.47	11.67	13.03	12.98	12.12
		LOT II—SEEDLINGS TRANSPLANTED, SURFACE-IRRIGATED								
0.52	13.54	5.18	7.51	9.02	9.84	10.81	11.22	12.09	12.36	12.37
0.78	20.31	5.48	7.88	10.93	11.17	11.74	11.79	15.74	15.97	15.50
1.56	40.63	6.39	8.65	11.54	11.78	12.75	13.20	14.63	14.82	14.79
2.34	60.94	6.52	8.89	11.78	11.97	12.14	12.79	13.51	14.16	14.08
3.12	81.25	7.38	9.21	12.01	12.63	12.67	12.90	13.52	13.52	14.08
		LOT III—SEEDLINGS NOT TRANSPLANTED, SUBSURFACE-IRRIGATED								
0.52	13.54	9.64	11.58	15.52	16.89	18.27	16.84	16.47	16.77	16.30
0.78	20.31	9.92	11.94	14.50	15.17	14.28	14.57	15.52	15.41	15.43
1.56	40.63	7.74	9.79	12.74	13.08	13.78	14.07	13.69	13.66	13.24
2.34	60.94	7.54	9.21	11.68	11.75	11.85	12.00	12.54	12.59	12.02
3.12	81.25	7.59	8.93	12.06	11.24	10.98	11.12	11.82	11.79	12.22
		LOT IV—SEEDLINGS TRANSPLANTED, SUBSURFACE-IRRIGATED								
0.52	13.54	5.31	7.66	12.45	11.68	16.40	16.16	17.87	17.39	18.31
0.78	20.31	5.67	7.89	13.53	15.27	15.08	15.35	16.62	16.08	14.52
1.56	40.63	6.21	8.23	12.69	13.25	13.52	14.01	14.18	14.61	14.23
2.34	60.94	6.07	8.22	9.99	10.55	8.72	9.12	9.13	9.20	9.32
3.12	81.25	5.63	7.60	10.01	10.60	8.20	8.52	7.49	7.77	7.46

[a] Corresponding frequencies of these figures are found in table 4b.

TABLE 3a

Comparison of the weights of onion plants in first planting subjected to different amounts of irrigation water, modes of irrigation, and methods of planting [a]

AMOUNT OF WATER		MODE OF APPLICATION	NOT TRANSPLANTED					TRANSPLANTED				
			Can number				Mean wt. of each can	Can number				Mean wt. of each can
			1	2	3	4		1	2	3	4	
liters	*ha. cm.*		*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*
0.78	32.50	Surface	109.10	88.00	96.00	121.00	103.55	72.60 [b]	89.80	76.70	84.10	80.80
		Subsurface	48.90 [d]	89.00	98.30	77.70	78.48	100.90	103.30	63.20	70.74 [d]	84.45
1.56	65.00	Surface	142.90	111.20	101.10	71.60	106.70	87.20	83.90	104.00	87.20	90.60
		Subsurface	27.10 [c]	45.50 [b]	39.00 [b]	26.70 [c]	34.58	47.70 [b]	46.40	17.40 [c]	62.90	43.60
2.34	97.50	Surface	74.50	77.90	21.70 [c]	59.30	58.85	83.30	64.60	29.90 [c]	15.30 [e]	48.28
		Subsurface	42.50 [b]	34.80	38.40	48.90 [b]	41.15	10.40 [b]	34.10	44.50 [b]	54.10	43.20
3.12	130 00	Surface	61.20	73.90	61.30	40.20 [b]	59.15	44.30 [c]	42.00 [b]	35.70 [c]	66.80	46.93
		Subsurface	37.10 [c]	45.80 [b]	33.20 [c]	17.80 [b]	33.48	28.30 [c]	27.90 [b]	34.60 [c]	43.90	33.95
3.90	162.50	Surface	71.80	51.20	34.30 [b]	48.10 [b]	51.36	28.50 [b]	11.40 [d]	48.60 [b]	60.50	37.25
		Subsurface	9.60 [e]	24.90	13.50 [c]	59.00	26.75	40.20 [b]	11.00	37.70	48.90	34.45

[a] Total weight of five plants, unless specified.
[b] Total weight of four plants.
[c] Total weight of three plants.
[d] Total weight of two plants.
[e] Weight of one plant.

TABLE 3b

Comparison of the weights of onion plants in second planting subjected to different amounts of irrigation water, modes of irrigation, and methods of planting [a]

AMOUNT OF WATER		MODE OF APPLICATION	NOT TRANSPLANTED					TRANSPLANTED				
			Can number				Mean wt. of each can	Can number				Mean wt. of each can
liters	*ha. cm.*		1	2	3	4		1	2	3	4	
			gm.	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*
0.52	13.54	Surface	63.10	53.20	47.20	78.10	60.40	48.50	45.90	57.20	40.50	48.28
		Subsurface	117.20	104.10	105.00 [b]	81.60 [b]	101.98	144.40	119.40	117.20	109.30	122.58
0.78	20.31	Surface	103.60	93.70	76.80	97.50	92.90	84.90 [b]	93.80 [b]	100.20	81.10	90.00
		Subsurface	66.60 [b]	151.30	110.00	74.70 [b]	100.65	94.40	105.40	120.90	97.10 [b]	104.45
1.56	40.63	Surface	76.10	86.30 [c]	118.90	94.60 [b]	93.98	78.30 [b]	83.70	56.30	100.20	79.63
		Subsurface	61.10 [b]	67.00	58.70	90.20 [b]	69.25	93.89	115.00	81.80 [b]	54.40 [b]	86.25
2.34	60.94	Surface	111.80 [b]	104.80	85.70	83.10	96.35	49.90	74.00	62.50 [b]	70.60	64.25
		Subsurface	109.60	45.50 [b]	38.50	50.00 [b]	60.90	18.40 [d]	28.50 [c]	53.70	59.90 [b]	39.63
3.12	81.25	Surface	48.40 [c]	65.60 [b]	80.20	62.30 [b]	64.13	75.40	58.20 [b]	55.60 [b]	48.10	59.33
		Subsurface	37.40 [b]	54.80	62.40	35.30	47.48	33.50 [b]	21.60 [c]	38.50 [c]	30.20 [d]	30.93

[a] Total weight of five plants, unless specified.
[b] Total weight of four plants.
[c] Total weight of three plants.
[d] Total weight of two plants.

TABLE 4a

Weekly record of the living plants from the beginning to the end of observation of the first planting

AGE OF THE PLANTS IN DAYS	LOT I Surface, not transplanted					LOT II Surface, transplanted				
	1	2	3	4	5	1	2	3	4	5
61	20	20	20	20	20	20	20	20	20	20
68	20	20	20	20	20	20	20	20	20	20
75	20	20	20	20	20	20	20	20	20	20
82	20	20	20	20	20	20	20	20	20	20
89	20	20	20	20	20	20	20	20	20	20
96	20	20	20	20	20	20	20	20	20	20
103	20	20	20	20	20	20	20	17	18	18
110	20	20	20	20	20	20	20	17	18	18
117	20	20	20	20	20	20	20	17	18	18
124	20	20	19	19	20	20	20	17	18	17
131	20	20	19	19	20	20	20	17	17	17
138	20	20	19	19	20	20	20	16	17	16
145	20	20	19	19	20	20	20	16	16	16
152	20	20	18	19	18	20	20	15	15	16
159	20	20	2	19	18	19	20	14	15	15
Dead plants ...	0	0	10	1	2	1	0	6	5	4
Per cent	0	0	18	5	10	5	0	30	25	25

TABLE 4a (continued)

AGE OF THE PLANTS IN DAYS	LOT III Subsurface, not transplanted					LOT IV Subsurface, transplanted				
	1	2	3	4	5	1	2	3	4	5
61	20	20	20	20	20	20	20	20	20	20
68	20	20	20	20	20	20	20	20	20	20
75	20	20	20	20	20	20	20	20	20	20
82	20	20	20	20	20	20	20	20	20	20
89	20	20	20	20	20	20	20	20	20	20
96	20	20	20	20	20	20	20	20	20	20
103	20	16	19	18	19	19	19	19	17	19
110	20	16	19	16	19	19	19	18	17	19
117	20	16	19	14	19	19	19	18	17	19
124	20	16	18	14	19	19	18	18	17	19
131	20	15	18	14	18	19	18	18	17	19
138	18	14	18	14	16	19	18	18	16	19
145	18	14	18	14	15	19	18	18	15	19
152	18	14	18	14	15	19	18	18	15	19
159	18	14	18	14	14	19	18	18	15	19
Dead plants ...	2	6	2	6	5	1	2	2	5	1
Per cent	10	30	10	30	25	5	10	10	25	5

TABLE 4b

Weekly record of the living plants from the beginning to the end of observation of the second planting

AGE OF THE PLANTS IN DAYS	LOT I					LOT II				
	Surface, not transplanted					Surface, transplanted				
	1	2	3	4	5	1	2	3	4	5
64	20	20	20	20	20	20	20	20	20	20
71	20	20	20	20	19	20	20	20	20	20
78	20	20	20	20	18	20	19	20	20	20
85	20	20	18	20	18	20	19	20	20	20
92	20	20	18	20	18	20	19	20	20	20
99	20	20	17	20	17	20	19	19	20	19
106	20	20	17	20	17	20	19	19	20	19
113	20	20	17	19	17	20	18	19	19	19
120	20	20	17	19	17	20	18	19	19	19
127	20	20	17	19	17	20	18	19	19	18
Dead plants ...	0	0	3	1	3	0	2	1	1	2
Per cent	0	0	15	5	15	0	10	5	5	10

TABLE 4b (continued)

AGE OF THE PLANTS IN DAYS	LOT III					LOT IV				
	Subsurface, not transplanted					Subsurface, not transplanted				
	1	2	3	4	5	1	2	3	4	5
64	20	20	20	20	20	20	20	20	20	20
71	20	20	20	20	20	20	20	20	20	20
78	20	20	20	20	20	20	20	20	20	20
85	20	19	20	20	20	20	20	20	19	20
92	20	19	20	20	20	20	20	20	19	20
99	19	18	20	20	19	20	20	20	15	15
106	19	13	20	20	19	20	20	20	15	15
113	18	18	19	18	19	20	19	18	14	12
120	18	18	19	18	19	20	19	18	14	12
127	18	18	18	18	19	20	19	18	14	12
Dead plants ...	2	2	2	2	1	0	1	2	6	8
Per cent	10	10	10	10	5	0	5	10	30	40

TABLE 5

Weather observations during the two plantings of onion [a]

PLANTING	TEMPERATURE		AV. RELATIVE HUMIDITY	RAINFALL		CLOUDINESS
	Av. minimum	Av. maximum		Total	Distribution	
	°C	°C.	*per cent*	*cm.*	*days*	*visibility*
First	22.92	29.40	85.20	41.06	72	7–9
Second	23.11	30.60	78.22	29.57	37	7–9

[a] The data were taken from the weather station of the College of Agriculture.

TABLE 6

Total amount of water applied and seasonal precipitation in the two plantings of onion

PLANTING	FREQUENCY	AMOUNT OF WATER APPLIED						RAINFALL	
		10 per cent[a]	15 per cent	30 per cent	45 per cent	60 per cent	75 per cent	Total	Distribution
	days	*ha. cm.*	*ha. cm.*	*ha. cm.*	*ha. cm.*	*ha. cm.*	*ha. cm.*	*cm.*	*days*
First	24	—	32.50	65.00	97.50	130.00	162.50	41.06	72
Second ...	15	13.54	20.31	40.63	60.94	81.25	—	29.57	37

[a] Based on the water-holding capacity of the soil (air-dry sample).

THE FIRST RATOON, FIRST-GENERATION PLANT CANES, AND PARENTS OF (POJ 2878 × P. S. A. 14) F_1 SEEDLINGS [1]

VALERIANO C. CALMA AND ROMAN R. ANDAY

A study of the variability of the first-generation ratoon and the first-generation plant canes of (POJ 2878 × P. S. A. 14) F_1 seedlings, alone and in comparison with their parents, and of the isolation of the best seedlings was made from April, 1947, to March, 1948, in the Department of Agronomy, College of Agriculture.

MATERIALS AND METHODS

The first ratoon and five cuttings each of the 98 seedlings selected by Calma and Samonte [2] and five cuttings each of the two parent plants, POJ 2878 and P.S.A. 14, were used in the study.

The writers piled the cut tops and leaves on the stubs, which were cultivated and allowed to ratoon, or produce shoots, in order that the first-generation asexual offspring in the ratoon stage could be studied. For the first-generation plant canes of the hybrid seedlings and their parents, seed pieces, 25 to 30 centimeters long, with at least three viable buds each were soaked in water for 48 hours and planted in furrows one meter apart in hills 75 centimeters apart. After germination, the plants were thinned to five cuttings to a row and only one cutting to a hill.

About one and a half months after planting, when the land was very dry, the plants were watered with a water hose. Missing hills in each row were replanted. When the plants were two months old, thoroughly mixed, decomposed manure was applied at the rate of three kilograms to a hill. Another month later, ammonium sulfate was applied at the rate of 25 grams to a hill, or about 325 kilograms to the hectare, to the plant canes and 30 grams to a hill, or about 400 kilograms to the hectare, to the ratoon plants. The fertilizer was applied at the base of each plant in a trench about five centimeters deep. The ratoon plants were cultivated with a grub hoe. The planted cuttings were cultivated by alternate hilling-up and off-barring with a native plow. Hand weeding was done around the base of the plants where the plow could not reach. The prevalence of diseases was minimized by removing the diseased portions of the affected plants.

---

[1] Central Experiment Station Contribution No. 1623, presented by the junior author as thesis for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1948.

[2] CALMA, V. C., AND H. A. SAMONTE. 1947. A study of the agronomic characteristics of (POJ 2878 × P. S. A. 14) F_1 hybrid sugar cane seedlings. Philippine Agriculturist **31**: 34–43. *Fig. 1.*

Variability in characters was observed in the first ratoon plants, first-generation plant canes, and parents of the different seedlings from the early stages of their growth to about twelve months after.

RESULTS AND DISCUSSION

The germination of the first ratoon, first generation plant canes, and parents of the different seedlings was not uniform because of the dryness of the soil. The tillers wilted during the hottest part of the day. Some ratoon stubs did not send out shoots, and the dead stubs were eaten by termites.

Two months after harvest, the first ratoon plants had many tillers. The plants from the seed pieces produced the greatest number of tillers in about three months, from about the end of June, 1947, to the middle of July, 1947, when there were frequent heavy rains. P.S.A. 14 produced the most tillers about the first week of August, 1947, or four months after planting. Strong winds or typhoons on August 10, 28, and 29, October 6, and 31, and December 25 to 26, 1947, caused the plants to recline and forced some to lodge. The production of tillers declined from August, 1947. The canes that lodged continued to produce tillers up to maturity.

At the age of about eight months, the ratoon canes flowered. Three of the seedlings from the seed pieces, including one of the parents, POJ 2878, flowered two weeks later. Most of the stools in both the ratoon and plant canes did not flower. The nonflowering habit is an advantage to the farmer who utilizes the tops as feed for his animals. In the study by Calma and Samonte [3] of the first-generation sexual seedlings, no plant flowered even after 14 months in the seedbed, or about 9 months after transplanting.

A summary of the habit of growth, color of stalks, position and persistence of leaves, presence of hairs on leaves, shape and prominence of buds, presence or absence of growth and cork cracks, and flowering habit of the ratoon, plant canes, and parents is presented below:

	RATOON		PLANT CANES	
HABIT OF GROWTH	No. of stalks	Percentage	No. of seedlings	Percentage
Open	32	36.77	30	30.61
Close	55	63.23	68	68.39
Erect	9	10.34	0	00.00
Reclining	36	41.38	48	48.98
Lodging	42	48.28	50	51.02
COLOR OF STALKS				
Light green	26	29.89	28	28.58
Yellowish-green	46	52.87	47	47.96
Purple	6	6.90	14	14.28
Yellowish-white	9	10.34	9	9.18
POSITION AND PERSISTENCE OF LEAVES				
Upright	16	18.39	10	10.20
Bending	71	81.61	88	89.90
Persistent	58	66.67	63	64.29
Deciduous	29	33.33	35	35.71

[3] *Ibid.*

HAIRS ON LEAVES				
Present	23	26.44	17	17.35
Absent	64	73.56	81	82.65
SHAPE AND PROMINENCE OF BUDS				
Not prominent	31	35.64	36	36.73
Prominent and rounded	41	47.12	51	52.04
Prominent and pointed	15	17.24	11	11.23
PRESENCE OF CORK AND GROWTH CRACKS				
Growth and cork cracks	16	18.39	13	13.27
Growth cracks	9	10.34	6	6.12
Cork cracks	33	37.94	23	23.47
Without cork and growth cracks	29	33.33	56	57.14
FLOWERING HABIT				
Flowering	8	9.19	13	13.27
Nonflowering	79	90.81	85	85.73

Parent plants of the different seedlings

HABIT OF GROWTH	
POJ 2878	Close and lodging
P. S. A. 14	Close and reclining
COLOR OF STALKS	
POJ 2878	Greenish-white when young and white when mature
P. S. A. 14	Light green when covered with leaf sheaths and purple when exposed
POSITION AND PERSISTENCE OF LEAVES	
P. S. A. 14	Bending and deciduous
POJ 2878	" " "
HAIRS ON LEAVES	
P. S. A. 14	Absent
POJ 2878	Present
SHAPE AND PROMINENCE OF BUDS	
POJ 2878	Prominent and rounded
P. S. A. 14	Not prominent
PRESENCE OF CORK AND GROWTH CRACKS	
POJ 2878	Growth and cork cracks present
P. S. A. 14	Absent
FLOWERING HABIT:	
POJ 2878	Flowering
P. S. A. 14	Nonflowering

Close stooling was observed in more plants of the first-generation ratoon and the plant canes of the seedlings. It is evident that the close stooling of both parents was inherited by the offspring. Of the 87 first-generation ratoon seedlings studied, 42, or 48.28 per cent, had lodging stalks. Of the first-generation plants canes of the seedlings, 50, or 51.02 per cent lodged, and 48, or 48.98 per cent, reclined. P.S.A. 14 had reclining stalks, whereas POJ 2878 lodged to the ground. This lodging characteristic of the first ratoon and plant canes of the seedlings and of the parents was not found by Calma and Samonte [4] who reported that most of the seedlings inherited the upright growth of the parent plants. The lodging noted in this work may have been due to the successive typhoons.

[4] *Ibid.*

POJ 2878 is greenish-white when young and turns yellowish-white when mature. P.S.A. 14 is light green but turns purple when exposed to the sun. In the first generation of the ratoon and plant canes, yellowish-green predominated over light green, yellowish-white, and purple, showing that the color combination of the parents was acquired by the crosses.

Most of the canes produced bending and persistent leaves. Some bore upright and deciduous leaves. Self-trashing is good for commercial canes because it makes harvesting easier.

Most of the plants had no hairs on the leaves unlike the parent POJ 2878. There were more stalks with prominent and rounded buds, which is a character inherited from POJ 2878. The production of prominent buds is desirable because it insures a good rate of germination.

Most of the first-generation plant canes had no growth and cork cracks, which are avenues for pests and diseases. Most of the POJ 2878 stalks produced growth cracks, but P.S.A. 14 did not show any growth or cork cracks. Apparently, the first-generation plant canes inherited this character from the P.S.A. 14 parent.

A summary of the data on pests and diseases observed is as follows:

	RATOON		PLANT CANES	
DISEASE OR PEST	No. of stalks	Percentage	No. of seedlings	Percentage
Rusts	28	32.18	25	25.51
Mechanical tangle top	4	4.59	0	0.00
Fiji disease	0	0.00	3	3.06
Disease-free plants	55	63.23	70	71.43
Yellow leaf spot				
Very slightly affected	14	16.10	25	25.51
Slightly affected	18	20.69	18	18.36
Badly affected	22	25.28	22	22.45
Very badly affected	29	33.34	28	28.58
Plants not affected	4	4.59	5	5.10
Rats	8	8.16	11	11.23
Gray borer	5	5.10	6	6.12
Mealy bugs	3	3.06	4	4.08
Termites	11	11.23	0	0.00
Wooly aphids	0	0.00	5	5.10
Plants not attacked by pests	71	72.45	72	73.47

PARENT PLANTS

Effect of yellow leaf spot

POJ 2878	Very slight
P. S. A. 14	Slight

The most prevalent diseases was yellow leaf spot in varying degrees of infection. Fiji disease occurred in the first-generation plant canes of the seedlings, although only 15 stools representing 3 different seedlings were attacked. Another common disease was rust caused by *Puccinia kuehnii* (Kr.) Butler, which infected 28 stools, or 32.18 per cent of the first-generation ratoon canes, and 25 seedlings, or 25.51 per cent of the first-generation plant canes.

There were 11 stools, or 11.23 per cent of the seedlings, which had termites in the ratoon. In the first-generation plant canes, rats caused damage to 11 seedlings, or 11.23 per cent. Other insect pests, like the sugar cane gray borer *Olethreutes schistaceana* (Snellen), mealy bugs *Trionymous sacchari* (Cockerell), and the wooly aphid *Ceratovacuna lanigera* Zehnter, were noted. The parent canes were relatively free from insect pests. They were only slightly infected with the yellow leaf spot.

As a whole, the variation in characters of agronomic importance observed by Calma and Samonte [5] was also noted in the first-generation ratoon and the first-generation plant canes.

Table 1 shows the means and coefficients of variation of the weight and number of millable stalks in a stool, height, diameter, length of internode, weight, and apparent purity of representative millable stalks of the first-generation ratoon and the first-generation plant canes of the different seedlings.

In number of millable stalks in the stool, the ratoon canes had a mean of 6.49 $\mp$ 0.53 and the plant crop, 7.50 $\mp$ 0.21. The first-generation ratoon canes had a coefficient of variation of 76.74 per cent, and the first-generation plant canes, 26.00 per cent.

The mean values for length of millable stalks were 144.77 $\mp$ 2.21 centimeters for the first-generation ratoon and 179.34 $\mp$ 0.85 centimeters for the first-generation plant canes. The length of millable stalks as a character, however, had a greater coefficient of variability value in the ratoon than in the plant crop of the seedling canes. These values were 26.06 per cent in the ratoon and 14.98 per cent in the plant canes.

The ratoon canes had also a higher degree of variability in diameter of stalks than the plant crop. The mean diameter of millable stalks of the ratoon was 2.13 $\mp$ 0.02 centimeters and of the plant crop, 2.23 $\mp$ 0.01 centimeters. The first-generation ratoon canes had a coefficient of variation of 12.84 per cent, and the first-generation plant canes, 9.09.

A greater variation in length of internode was noted in the ratoon canes which had a coefficient of variation of 17.69 per cent. The first-generation plant canes had 13.77 per cent.

The weight of millable stalks in the stool also varied. The mean weight of millable stalks produced by the plant crop was 6.70 $\mp$ 0.08 kilograms, or a coefficient of variability of 29.01 per cent; that of the first-generation ratoon canes, 3.63 $\mp$ 0.14 kilograms, or a coefficient of variation of 61.15 per cent. The number, diameter, and length of millable stalks all contributed to the variation in weight.

The first-generation ratoon canes had a mean apparent purity of 84.95 $\mp$ 1.11 per cent and a coefficient of variation of 5.23 per cent; the first-generation plant canes had a mean apparent purity

[5] *Ibid.*

of 80.79 ∓ 0.88 per cent and a coefficient of variation of 10.80 per cent.

On the whole, the ranges of variation in number of millable stalks, length of millable stalks, length of internodes, and weights of millable stalks in a stool were wider in the first-generation ratoon than in the first-generation plant canes.

Table 2 is a summary of the important characters exhibited by both parents, the first-generation ratoon, and the first-generation plant canes of the seedlings canes. The parents had a higher mean percentage of apparent purity than the first-generation ratoon or first-generation plant canes of the seedlings. However, the first-generation plant crop was better than the parents in weight and number of millable stalks in a stool and in average length of internodes. This result corroborates the finding of Morales[6] that the asexual seedlings from (P.B. 119 × C.A.C. 87)F_1 hybrids are superior to the parents in tonnage of canes and number of millable stalks in the stool. The first-generation ratoon canes had lower values of the characters studied, except average length of internode and number of millable stalks in a stool, than the better parent, POJ 2878.

The coefficient of heredity between the first ratoon and the first-generation plant canes in total number of millable stalks shows that there was asexual inheritance of that character between the two crops. There was no correlation in weight of millable stalks in a stool between the ratoon and the plant cane crops.

The selection of seedlings was made immediately after the study of the agronomic characters and the analysis of juice of each seedling and parent. The bases for selection were the mean values for percentage of apparent purity and weight of millable stalks in a stool. Seedlings Nos. 71, 137, and 46 had higher mean weights of millable stalks in a stool than either of the parents and had fairly high percentages of purity, ranging from 78.45 to 88.39 per cent. A fourth seedling, No. 93, may also be selected because it had a mean weight of 11.04 kilograms millable stalks to the stool and an apparent purity of 88.47 per cent, which is higher than that of any of the three seedlings.

SUMMARY

1. In the first-generation ratoon and first-generation plant canes of the 98 selected seedlings from (POJ 2878 × P.S.A. 14)F_1 offspring and in the five plants each of the parent varieties, variability in habit of growth, color of stalks, position and persistence of leaves, hairs on leaves, shape and prominence of buds, and presence of growth and cork cracks was noted.

2. Some of the seedlings were infected with minor diseases. Fiji, a major disease of sugar cane, infected three plant canes of the

[6] Morales, E. M. 1928. A study of (P. B. 119 × C. A. C. 87)F_1 hybrid and other sugar-cane seedlings and their parents. Philippine Agriculturist 16: 543–556.

first-generation seedlings. Some apparently disease-free plants were observed in both the ratoon and plant canes. The parent plants were slightly affected by leaf spot. Only a few seedlings were attacked by pests, the most common of which were rats.

3. A higher degree of variability in the weight and number of millable stalks in a stool, length and average diameter of millable stalks, and length of internode was observed in the first-generation ratoon and first-generation plant canes of the different seedlings. The range of variation in all instances except in percentage of apparent purity of juice was wider in the first-generation ratoon plants than in the first-generation plant canes.

4. The number of millable stalks in a stool of the ratoon was inherited by the first-generation plant canes, and the weight of millable stalks in a stool was asexually inherited from the first ratoon of plant cane.

5. Of a total of 98 seedlings, only three, Nos. 71, 137, and 46, or 9.06 per cent of the first-generation plant canes of the first-generation sexual seedlings, were significantly higher than either of the parents in weight of millable stalks in a stool and had fairly high percentages of purity of juice, ranging from 78.45 to 88.39 per cent. Seedling No. 93 had a mean weight of 11.04 kilograms of millable stalks in a stool and an apparent purity of 88.47 per cent. None of the first-generation plant canes of the first-generation seedlings gave an apparent purity higher than or equal to POJ 2878.

RECOMMENDATION

The writers recommend that seedlings Nos. 71, 137, 46, and 93 be multiplied and their performance compared with a well-established sugar cane variety.

TABLE 1

Means and coefficients of variation of the weight and number of millable stalks in a stool, length, diameter, length of internode, and apparent purity of representative millable stalks of the first-generation ratoon canes and the first-generation plant canes of the first-generation sexual seedlings

ITEM	FIRST-GENERATION RATOON CANES		FIRST-GENERATION PLANT CANES	
	Mean	Coefficient of variation	Mean	Coefficient of variation
		per cent		*per cent*
Weight of millable stalks in a stool in kilograms	3.63 ∓ 0.14	61.15	6.70 ∓ 0.08	29.01
Number of millable stalks in a stool	6.49 ∓ 0.53	76.74	7.50 ∓ 0.21	26.00
Diameter of millable stalks in centimeters	2.12 ∓ 0.02	12.84	2.23 ∓ 0.01	9.09
Length of millable stalks in centimeters	144.77 ∓ 2.21	26.06	179.34 ∓ 0.85	14.98
Length of internode of millable stalks in centimeters ..	12.76 ∓ 0.13	17.69	13.59 ∓ 0.06	13.77
Apparent purity in per cent	84.95 ∓ 1.11	5.23	80.79 ∓ 0.88	10.80

TABLE 2

Summary of the important agronomic characters of the millable stalks of the parent plants, first-generation ratoon canes, and first-generation plant canes of the first-generation sexual seedlings

VARIETIES	WEIGHT OF A STOOL	AVERAGE LENGTH	AVERAGE DIAMETER	AVERAGE LENGTH OF INTERNODE	NUMBER IN A STOOL	APPARENT PURITY
	kg.	*cm.*	*cm.*	*cm.*	*cm.*	*per cent*
POJ 2878	6.02 ∓ 0.19	180.30 ∓ 6.41	2.40 ∓ 0.08	11.50 ∓ 0.53	5.8 ∓ 0.63	91.05
P. S. A. 14	2.52 ∓ 0.13	148.40 ∓ 8.65	2.75 ∓ 0.08	9.49 ∓ 0.48	2.8 ∓ 0.26	86.24
First-generation ratoon canes ...	3.63 ∓ 0.14	144.77 ∓ 2.21	2.12 ∓ 0.02	12.76 ∓ 0.13	6.49 ∓ 0.53	84.95
First-generation plant canes	6.70 ∓ 0.08	179.34 ∓ 0.85	2.23 ∓ 0.01	13.59 ∓ 0.06	7.5 ∓ 0.21	80.79

THE INFLUENCE OF 2,4-D SPRAYS ON MELONS AND WATERMELONS WITH SPECIAL REFERENCE TO SEEDINESS AND WEIGHT OF THE FRUITS [1]

José M. Capinpin and Narciso M. Natividad

In the United States, 2,4-D has been successfully used as a fruit-setting hormone by Howlett (1941), Zimmerman (1941), Gustafson (1942), and Strong (1946). Van Overbeek (1945) stated that it could also be used to hasten fruiting in pineapple.

In the Philippines, Villariba and Capinpin (1948) reported that the best concentration of 2,4-D for inducing parthenocarpy and increasing fruit set, as well as for reducing the number of days from blossoming to ripening, was 25 parts per million. Hartmann (1950) found that 4 parts per million and 8 parts per million of 2,4-D gave better results in fruit set and yield of olives than the control.

The object of the present study was to determine the influence of varying concentrations of 2,4-D on melons (*Cucumis* melo L.) and watermelons (*Citrullus vulgaris* Schrad.), with special reference to the seediness and weight of the fruits. The study was conducted in the Department of Agricultural Botany, College of Agriculture, Los Baños, from December, 1949, to October, 1951.

MATERIALS AND METHODS

The prepared experimental plots were fertilized with liberal amounts of decomposed chicken manure.

Seedlings of melons, *Kinastila* variety, and watermelons, Santa Maria variety, were grown in seedboxes until they were eight centimeters tall and were transplanted three seedlings to a hill. During the vegetative stage, insects, particularly squash beetles, were controlled by hand-picking and by spraying with insecticides at three-day intervals.

Since melons and watermelons are unisexual, no emasculation was done. Fresh solutions of the desired concentration of 2,4-D were sprayed on flowers with a De Vilbiss atomizer. Care was taken to confine the spray to the flowers to avoid leaf deformation. Gustafson (1942), working on tomato, used the spray method of applying emulsions containing growth-promoting compounds.

All applications were made during hot sunny days. The treated flowers were bagged; the bags were left on the flowers until the latter fell off. Insecticides were sprayed on enlarging ovaries because of the presence of fruit flies. The fruits that formed were left on the plant until they ripened and then they were picked and examined.

---

[1] Central Experiment Station Contribution No. 1624. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1951.

EXPERIMENTS AND RESULTS

Melon. Two plantings of *Kinastila* variety were made, one on December 13, 1949, and the other on January 2, 1951. Each planting or set was composed of 40 hills.

In the first planting, 2,4-D was applied from January 21, 1950, to March 5, 1950, during which time pistillate flowers occurred. Staminate flowers developed first, followed by pistillate flowers. The pistillate flower buds and open flowers were sprayed once. For every group of treatments of 15, 20, and 25 parts per million, there was a corresponding control which did not receive 2,4-D. The enlarging fruits were examined and were harvested when they showed signs of maturity, which were the change in color from green to pale yellow and emission of a pleasant smell. They were then weighed and further examined.

The second planting was treated from March 17, 1951, to April 30, 1951. The results of the two plantings may be seen in table 1.

Watermelon. As with melon, two plantings of the Santa Maria variety of watermelons were made, one on January 5, 1950, and the other on January 13, 1951.

The first planting was treated from February 23, 1950, to March 13, 1950. The pistillate flowers did not come out at the same time, so that the treatment had to be extended. For every group of treatments of 15, 20, and 25 parts per million, there was one control which received no 2,4-D. The enlarging fruits were observed until they ripened. The fruits were harvested when they were mature, as indicated by the drying of the tendril-like structure at the point of attachment of the pedicel to the main stem of the plant. Further studies of the fruits were made in the laboratory.

The second planting was treated from March 4, 1951, to April 6, 1951. The results of the two plantings are presented in table 1.

DISCUSSION

Melon. The weights of the fruits from plants sprayed with the three concentrations of 2,4-D varied. Table 1 indicates that 2,4-D treatment reduced the weight of fruits and the number of fruits formed. The treated fruits were malformed. These observations corroborate the findings of Villariba and Capinpin (1948).

The texture and taste of the fruits of the treated plants differed little from the control. The treatment seemed to reduce the number of seeds. Ordinarily, melons are watery in texture, but when ripe they are somewhat glutinous and have a sugary taste. The result obtained from the treatment seems to agree with the observation by Janes (1941) that parthenocarpic fruits became sweeter when the plants were treated with 2,4-D.

The 25 parts per million concentration of 2,4-D spray was found most effective for reducing the seeds. In the first planting, the

average number of seeds in the untreated fruits was 691.3 ∓ 13.34; in fruits treated with 15 p.p.m. 2,4-D, 610.8 ∓ 15.25; in those treated with 20 p.p.m. 2,4-D, 565.3 ∓ 13.52; and in those treated with 25 p.p.m. 2.4-D, 455.8 ∓ 24.05. The same trend of results was noted in the second planting.

The seeds were tested for viability. Those from the control plants were 91 per cent viable in the first planting. The percentages of viability of the seeds of plants treated with 15 p.p.m., 20 p. p.m., and 25 p.p.m. 2,4-D were 68.3, 35.0, and 31.5, respectively. The results show that the treated plants produced less viable seeds because of the toxic effect of the growth regulator.

Concerning the effect on fruit setting, the writers obtained results different from those of other workers. According to Rees (1947), Howard Keddie observed that 8 p.p.m. 2,4-D spray showed no adverse fruit-setting effect on Valencia orange trees and that fruit drop was cut from 30 to 60 per cent. He further observed that stronger concentrations containing up to 25 p.p.m. cut fruit-drop loss to 90 per cent, especially at the beginning of fall. The results of the present experiment show that fruit set was adversely affected by the varying concentrations of 2,4-D. In the first planting, the percentage of fruit set of the control was 38.09; of plants treated with 15 p.pm. 2,4-D, 28.09; of those treated with 20 p.p.m. 2,4-D, 19.04; and of those treated with 25 p.p.m. 2,4-D, 14.28. In the second planting, the same trend of decreased percentage of fruit set was apparent. As far as fruit set of melon is concerned, no treatment of 2,4-D is necessary. Hartmann (1950), working on olives, reported that 4 p.p.m. and 8 p.p.m. of the 2,4-D hormones had better effects on fruit set and yield.

Although 25 p.p.m. of 2,4-D spray decreased the fruit set of melons, it shortened the period from blossoming to maturity to 32 days for the 25 p.p.m. 2,4-D-treated plants and 37 days for the control.

Watermelons. Watermelon responded to the three concentrations of 2,4-D spray in almost the same manner except in the degree of seediness. The plants sprayed with 20 p.p.m. 2,4-D in the first and second plantings produced fruits containing 162.4 ∓ 19.60 and 159.6 ∓ 12.18 seeds, respectively; those sprayed with the 15 p.p.m. treatment, 446.5 ∓ 20.40 and 392.3 ∓ 15.74; and those sprayed with the 25 p.p.m. treatment, 266.0 ∓ 4.63 and 242.1 ∓ 2.61. This effect differs from the findings of Villariba and Capinpin (1948) that 25 p.p.m. 2,4-D was the best concentration for reducing seeds. The treatment, however, also increased fruit set.

The morphological effects of 2,4-D on the experimental plants were quite noticeable. The flower buds were very sensitive to concentrations of 2,4-D. Most of them did not develop to full-sized fruits, particularly those treated with 25 p.p.m. 2,4-D. This result seems to differ from that reported by Villariba and Capinpin (1948) that fruits developed from open flowers sprayed with 25 p.p.m. 2,4-D

were normal in size or slightly larger than those from untreated flowers.

As to quality of the fruits, watermelons from plants treated with 25 p.p.m. 2,4-D were more crisp in texture, less watery, and sweeter than those from unsprayed plants.

The plants sprayed with 25 p.p.m. 2,4-D produced the lightest fruits. The weights of the control fruits in the first and second plantings were 2,326.4 ∓ 11.85 and 2,247.9 ∓ 11.03 grams, respectively; those of fruits from plants sprayed with 15 p.p.m. 2,4-D, 1,718.5 ∓ 10.84 and 1,894.5 ∓ 103.99 grams; and those of fruits from plants sprayed with 25 p.p.m., 1,206.0 ∓ 12.75 and 1,206.8 ∓ 11.03 grams.

The respective percentages of germination in the first and second plantings were 92 and 96 for the control, 62.3 and 61.00 for those treated with 15 p.p.m. 2,4-D, 39.3 and 48.6 for those treated with 20 p.p.m. 2,4-D, and 29.60 and 38.3 for those sprayed with 25 p.p.m. No explanation for the persistence of seeds in the treated fruits could be found. An examination of the seeds revealed that the embryos were dead. This caused the low percentage of germination.

An increased concentration of 2,4-D caused a decrease in the percentage of fruit set. The control had the highest percentage of fruit set.

Although there are certain disadvantages derived from the treatment of the pistillate flowers with 2,4-D spray, the period from blossoming to maturity of watermelons was shortened (table 1). For the control groups of the first and second plantings, the number of days from blossoming to maturity was 33.2 and 34.1, respectively; for the plants treated with 15 p.p.m. 2,4-D spray, 30.82 and 30.31; for those treated with 20 p.p.m. 2,4-D spray, 28.8 and 31.11 days; and for those treated with 25 p.p.m. 2,4-D, 27.72 and 28.88. Villariba and Capinpin (1948) similarly found that 25 p.p.m. of 2,4-D spray shortened the period from blossoming to maturity.

SUMMARY

1. With melon the concentrations of 15, 20, and 25 p.p.m. of 2,4-D spray did not increase fruit set or the weight of the fruits, but they reduced the seediness and the viability of seeds produced.

2. Of the three concentrations, 25 p.p.m. 2,4-D reduced most the number of days from blossoming to maturity of melon and watermelon.

3. Fruits from treated watermelon plants were lighter than those from untreated plants.

4. Of the three concentrations of 2,4-D, 25 p.p.m. was the best for reducing the number of melon seeds.

LITERATURE CITED

GUSTAFSON, F. G. 1942. B-naphtoxyacetic acid as induction of parthenocarpy in tomatoes. Proc. Amer. Soc. Hort. Sci. **40**: 387–389.

HARTMAN, H. T. 1950. Test with growth regulating chemicals for increasing fruit set and yield in olives. Proc. Amer. Soc. Hort. Sci. **55**: 181–189.

HOWLETT, F. S. 1941. Use of chemicals to stimulate fruitfulness in tomatoes. Amer. Rep. Veg. Growers Assoc. America **1941**: 1–13.

JANES, B. E. 1941. Some chemical differences between artificially produced parthenocarpic fruits of tomato. Amer. Jour. Bot. **28**: 639–646.

REES, CHARLES C. (editor) 1947. Orchards. Country Gentleman **117** (8): 38–39.

STRONG, M. C. 1946. Use of 2,4-D for the improvement of greenhouse tomato production. Amer. Jour. Bot. **33**: 130–141.

VAN OVERBEEK, J. 1945. Flower formation in the pineapple plant as controlled by 2,4-D and naphthalene acetic acid. Science **102**: (2659): 621.

VILLARIBA, C. A., AND J. M. CAPINPIN. 1948. Morphogenetic effects of 2,4-Dichlorophenoxyacetic acid. Philippine Agriculturist **31**: 163–170.

ZIMMERMAN, P. W. 1941. Growth regulators of plants and formative effects induced with B-naphthoxy compounds. Proc. Nat. Acad. Sci. **27**: 381–388.

TABLE 1

Effects of varying concentrations of 2,4-D spray on average weight of fruits, average number of seeds, percentage of fruit set, percentage of germination, and average period of maturity of Kinastila variety of melon (Cucumis melo L.[a]*) and Santa Maria variety of watermelon (Citrullus vulgaris* Schrad.[b]*)*

KIND OF PLANT USED	CULTURES	CONCENTRATIONS P.P.M.	AVERAGE WEIGHT OF FRUITS	AVERAGE NUMBER OF SEEDS	PERCENTAGE OF FRUIT SET	PERCENTAGE OF GERMINATION	AVERAGE PERIOD OF MATURITY
			grams				*days*
Melon	First Planting	control	928.4 ∓ 13.51	691.3 ∓ 13.34	38.09	91.60	37.12
		15	825.5 ∓ 9.38	610.8 ∓ 15.25	28.09	68.30	35.83
		20	730.3 ∓ 4.37	565.3 ∓ 13.52	19.04	35.00	33.50
		25 [c]	614.7 ∓ 28.27	455.8 ∓ 24.05	14.28	31.00	32.00
	Second Planting	control	940.2 ∓ 11.54	704.9 ∓ 3.03	57.14	90.00	37.56
		15	810.3 ∓ 23.09	559.9 ∓ 18.24	35.71	58.00	34.50
		20	748.9 ∓ 10.44	654.3 ∓ 12.05	28.57	48.00	34.88
		25	659.3 ∓ 18.55	493.8 ∓ 7.80	21.42	36.00	31.83
Watermelon	First Planting	control	2,326.4 ∓ 11.85	645.1 ∓ 26.50	28.48	92.00	33.20
		15	1,718.5 ∓ 10.84	446.5 ∓ 20.40	14.25	62.30	30.62
		20 [d]	1,504.6 ∓ 57.64	162.4 ∓ 19.60	22.85	39.30	28.80
		25	1,206.0 ∓ 12.75	266.0 ∓ 4.63	11.42	29.60	27.75
	Second Planting	control	2,247.9 ∓ 16.83	675.9 ∓ 13.44	62.5	96.00	34.10
		15	1,894.5 ∓ 103.99	392.3 ∓ 15.74	31.25	61.00	30.30
		20	1,498.9 ∓ 38.51	159.6 ∓ 12.18	28.12	48.6	31.11
		25	1,206.8 ∓ 11.03	242.1 ∓ 2.61	38.30	38.3	28.88

[a] First planting, planted December 13, 1949; treated from January 21, 1950, to March 5, 1950. Second planting, planted January 2, 1951; treated from March 17, 1951, to April 30, 1951.

[b] First planting, planted January 5, 1950; treated from February 23, 1950, to March 13, 1950. Second planting, planted January 13, 1950; treated from March 4, 1951, to April 6, 1951.

[c] Produced greatest decrease in number of seeds, percentage of fruit set, percentage of germination, and average days of maturity of melon.

[d] Produced the least seeds in watermelon.

MAKING GRASS SILAGE [1]

NESTOR C. VERA CRUZ

Silage making started in the College of Agriculture in 1929 when the dairy, draft, and beef animals increased to such a number that the pasture areas were not sufficient to supply them with succulent forage, especially during the dry months. Since then, making corn silage has become a yearly routine in providing the animals with supplemental feed (Esguerra, 1948).

Heretofore the College made silage from corn only, but according to Morrison (1949), grasses can be made into good silage whenever hay making is impossible and, in this form, are more palatable and have greater feeding value. Hence, a study was conducted to determine the efficacy of making grass silage, with cane molasses as preservative. This work was performed in the Department of Animal Husbandry from June, 1950, to February, 1951.

MATERIALS AND METHODS

Napier grass (*Pennisetum purpureum* Schum.) was used in this study because of its high yielding capacity. Calma and Ramos (1949) reported that among the four forage grasses cultured in the College, Napier grass gave the heaviest yield. They found that a hectare of Napier grass yielded 129,618.57 kilograms of soilage a year, higher than that reported by Villegas in 1936.

Galang and Paulino found in 1925 that Napier grass at 20, 30, and 40 days of age was palatable to horses, cattle, and carabao but became less so as it matured to 90 days. Napier grass was also found to be less palatable than Guinea grass (*Panicum maximum* Jacq.), bungalon (*Panicum stagninum* Retz.), Guatemala (*Tripsacum laxum* Nash.), and Para grass (*Panicum barbinode* Trin.).

The Napier grass used in this experiment was furnished by the Department of Agronomy. The crops were harvested when in full bloom in order to get the maximum yield of dry matter. The average height of the plants when cut was approximately 150 centimeters.

The cane molasses used for preservative was requisitioned from the Real Compaña de Azucarera in Real, Calamba, Laguna. It had the following proximate analysis [2] :

---

[1] Central Experiment Station Contribution No. 1625. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1951, No. 1742. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

[2] Analyzed by the Department of Agricultural Chemistry.

	per cent
Moisture	20.75
Crude fats (Ether extract)	3.99
Ash	7.23
Crude protein (N × 6.25)	0.71
Crude fiber	0.00
Nitrogen-free extract	67.32
Calorific value for every 100 grams	308.00

A Farmall Cub tractor was used to operate the ensilage cutter in the first trial, and a Farmall H was used in the second. To cut the Napier grass, an International Harvester Company No. 7 Ensilage Cutter was used. A large concrete pit was divided into five compartments, with a volume of 1.9 cu.m. each, and floored with lumber to form five individual silos adjacent to each other. A rectangular box, 4 in. by 4 in. by 28 in., with a sliding galvanized iron side was placed in the middle of the cut Napier grass in each silo.

A thermometer graduated in the centigrade scale was inserted through the side opening of each box in the silage to determine the temperature changes at intervals. The chopped fodder and the resulting silage were weighed on a Fairbanks scale sensitive up to one-tenth of a kilogram.

To determine the daily Napier grass silage consumption, duration of feeding, consumption in one minute, and consumption for each 100 kilograms live weight, five mature Red Sindhi cows were used. The average weight of the animals was 228.0 kilograms. The weight and herd number of the animals were: Laki, Herd No. 2—250.0 kg.; Culmore, Herd No. 3—240.0 kg.; Elaura, Herd No. 4—220.0 kg.; Malir, Herd No. 5—220.0 kg.; and Aires, Herd No. 6—210.0 kg.

The Napier grass was harvested with bolos and gathered into large piles in the field to prevent excessive evaporation of moisture. The ensilage cutter was mounted and then fed with Napier grass. The cut grass was weighed and dipped in a solution of molasses before it was placed in the silo. Filling was done gradually, each layer of grass being trampled thoroughly during the process.

In the first trial, 200 kilograms of cut Napier grass was placed in each silo after having been soaked in a solution of 11.0 kilograms cane molasses and 54.0 kilograms water, or a proportion of 1.0 kilogram molasses to 4.9 kilograms water. In the second trial, the amount of cut Napier grass was raised to 500 kilograms. Acacia leaves soaked in the molasses solution was placed on top of the ensiled material in every silo in the first trial in lieu of sealing material. In the second trial, Napier grass was used. Stones were placed on top of the ensiled material to press it down.

The initial and weekly temperatures of the silage in all the replications were taken at a depth of 45 centimeters from the top of

the ensiled material. Care was taken to allow three minutes to pass before the temperature was read.

Samples for pH value determinations were taken at weekly intervals 45 centimeters from the surface of the ensiled material. One gram of the sample was diluted with 10 milliliters of distilled water, and the pH value was determined with the Beckman pH meter.

The silage was taken out of the silos after three months and then fed to the cows. The cows were kept in separate stalls and given 10 kilograms of silage in the morning and 10 kilograms in the afternoon. Then the leftovers were weighed to determine the consumption of each cow in one day. The duration of feeding of each cow was also noted.

RESULTS AND DISCUSSION

Temperature changes

As cited by Esguerra (1940), Eckles, Oshel, and Magruder reported that good silage is produced at a temperature of from 50°F. to 100°F. (10°C. to 47.78°C.). In this experiment, the observed temperature of the silage was from 33.11°C. to 41.88°C. The initial temperature of the silage ranged from 36.0°C. to 37.0°C., or an average of 36.66°C. Twenty-four hours after ensiling, the temperature ranged from 40.0°C. to 41.5°C., or an average of 41.22°C. Thus, the average rise in temperature from ensiling up to one day of age of the silage was 4.56°C. The highest temperature was registered one week after ensiling, the average at that time being 41.89°C. The difference between the average temperature on the first day and the average temperature after one week was only 0.67°C.

It is interesting to note that the temperature of the silage began to decline after the first week, so that by the twelfth week, when the silage was taken out of the silo, the temperature was 31.16°C. The rise in temperature of the silage during the first week and the gradual decline after that time were consistent in all the replications.

pH value

The average initial pH value of the silage at various ages was 6.13. With the decline in temperature, the silage also became acidic. There was only a very slight change in the pH value of the silage during the first week, the average being 5.56. From the first week to the second week, an average difference of 1.22 was noted. The average pH value during the second week was 4.34. From that time on the pH value gradually decreased as the silage became more acidic, until an average pH value of 3.83 was recorded on the twelfth week, the end of the experiment. These changes in pH value of the silage was consistent in all the replications.

Yield of silage

The shrinkage or loss in weight of the material after ensiling ranged from 39.38 per cent in replication No. 5 to 48.20 per cent in replication Nos. 2 and 6. The average shrinkage was 45.57 per cent.

The total yield of both good and bad silage ranged from 51.80 per cent to 54.36 per cent, the average total yield being 54.37 per cent.

Spoiling was found in the uppermost layer of the ensiled material, this portion being more exposed to the outside air. The spoiled silage was from dark brown to black and had the characteristic odor of rotten farm manure. The percentage of spoilage ranged from 10.11 per cent to 22.44 per cent, or an average of 16.56 per cent of the total yield of silage.

The production of good silage fit for feeding purposes ranged from 77.55 per cent to 89.82 per cent, the average percentage being 83.43 per cent of the total yield.

Silage consumption

The average consumption of silage ranged from 13.73 kilograms by the cow Aires to 15.36 kilograms by the cow Malir. The average daily consumption of the cows was 15.00 kilograms a head. In 1939, Villegas and Elepaño reported that the amount of Laguna Yellow Flint corn silage consumed daily by Nellore cows ranged from 17.84 $\pm$ .14 to 24.14 $\pm$ .26 kilograms, or an average of 23.95 $\pm$ .18 kilograms. The results obtained in this experiment were lower because the cows used were smaller and lighter. The cows used by Villegas and Elepaño had an average weight of 366.2 kilograms, whereas those used in this experiment had an average weight of only 228.0 kilograms.

It took an average time of 79.26 minutes for the cows to consume 15.00 kilograms of silage. The range of duration of feeding was from 76.25 minutes by Laki to 78.33 minutes by Malir. The rate of consumption varied from 0.177 kilogram to 0.205 kilogram a minute, the average being 0.194 kilogram.

The average amount of Napier grass silage consumed for every 100 kilograms live weight of the animals was 6.58 kilograms, the amount varying from 5.98 to 7.16 kilograms. These figures are a little lower than those reported by Villegas and Elepaño (1939) which ranged from 5.7 to 7.7 kilograms, or an average of 7.3 kilograms for every 100 kilograms live weight.

Proximate analysis

Table 1 shows the proximate analysis of the fresh Napier grass and the Napier grass silage. The Napier grass silage was more succulent than the fresh Napier grass, the moisture content of the silage being 79.01 per cent, on the average, and that of the fresh material, 75.93 per cent. Fresh Napier grass contained 3.6 times as much

crude fats as the silage, the average percentage for the former being 4.31 per cent and for the latter, 1.23 per cent. Likewise, the calorific value for every 100 grams of the sample of fresh Napier grass was on the average of 70.00 per cent and of the Napier grass silage, 47.55 per cent. Both materials contained practically the same amount of crude protein, nitrogen-free extract, crude fiber, and ash. The crude protein of fresh Napier grass was 1.32 per cent and that of Napier grass silage, 1.35 per cent. The fresh Napier grass had 6.45 per cent nitrogen-free extract, 8.62 per cent crude fiber, and 3.57 per cent ash; the Napier grass silage had 7.67 per cent nitrogen-free extract, 7.52 per cent crude fiber, and 3.12 per cent ash.

Miscellaneous observations

Color. The silage in all the samples was at first brownish-green, then turned into yellow or amber as it became older.

Odor. The ensiled material started to have a characteristic silage odor two days after ensiling. At the beginning the smell was that of weak vinegar. Later, it became markedly acidic.

Feces of cows. There was no noticeable change in the color and consistency of the cows' feces, showing that the Napier grass silage fed to them was not only palatable but also wholesome.

Weight of cows. The weights of the cows at the start and at the end of the feeding period were practically the same. The average weights of the cows at the start was 228.0 kilograms and at the end of the feeding period, 229.1 kilograms.

SUMMARY

1. In an experiment on ensiling Napier grass with cane molasses as preservative, the temperature of the silage ranged from 33.11°C. to 41.88°C. The highest temperature was attained one week after ensiling, the average at that time being 41.89°C. The temperature after twelve weeks, or at the end of the experiment, was 31.16°C.

2. Napier grass silage became acidic as it became older. The initial pH value was 6.13 and the final average pH value was 3.83.

3. The total yield of silage was from 51.80 per cent to 54.36 per cent of the fresh grass ensiled, or an average of 54.37 per cent. Of this an average of 83.43 per cent was good silage and 16.56 per cent, spoiled silage.

4. Each of the 5 Red Sindhi cows used in the experiment consumed an average of 15.00 kilograms of feed daily at an average duration of feeding of 79.26 minutes. The average rate of consumption was 0.194 kilogram a minute, and the average silage consumption for every 100 kilograms live weight was 6.58 kilograms.

5. The moisture content of Napier grass silage was 79.01 per cent, and that of fresh Napier grass, 75.93 per cent. Fresh Napier grass contained 3.6 times as much crude fats as Napier grass silage. Likewise, the calorific value of the fresh Napier grass was higher

than that of the Napier grass silage. The calorific value of a hundred grams of fresh Napier grass was 70.00, whereas that of the Napier grass silage was only 47.55. Both materials contained approximately the same amounts of protein, fiber, nitrogen-free extract, and ash.

6. The Napier grass silage obtained in this experiment had a bright yellow or amber color and had the characteristic odor of corn silage.

CONCLUSION

Judging from the consumption records of Red Sindhi cows and from the proximate analysis, Napier grass silage is a palatable, wholesome, and nutritious feed for cattle.

LITERATURE CITED

CALMA, V. C., AND F. B. RAMOS. 1949. The culture of Guatemala grass, Guinea grass, Merker, and Napier for silage. Philippine Agriculturist 32: 276–282.

ESGUERRA, J. P. 1940. The cost of producing corn silage at the College of Agriculture. Philippine Agriculturist 29: 327–341.

ESGUERRA, J. P. 1948. Making corn-tapilan silage. Philippine Agriculturist 32: 71–78.

GALANG, F. G., AND P. L. PAULINO. 1925. A progress report on forage crop investigations at the Lamao Experiment Station, Lamao, Bataan. Philippine Agric. Rev. 18: 3–31.

MORRISON, F. B. 1949. Feeds and Feeding. 21st ed., vi + 1207 p. Ithaca, New York: Morrison Publishing Company.

VILLEGAS, VALENTE. 1936. The yield and productive life of Napier grass (*Pennisetum purpureum* Schum.) as soilage crop for farm animals. Philippine Agriculturist 25: 471–478.

VILLEGAS, VALENTE, AND ALBERTO ELEPAÑO. 1939. A comparative study of the amount of soilage and silage consumed by Philippine and Nellore cattle. Philippine Agriculturist 28: 543–552.

TABLE 1

Average percentage of nutrients and calorific value of fresh Napier grass and Napier grass silage

NUTRIENTS	FRESH NAPIER GRASS	NAPIER GRASS SILAGE
	per cent	*per cent*
Moisture	75.73	79.01
Crude protein	1.32	1.35
Crude fats	4.31	1.23
Nitrogen-free extract	6.45	7.67
Crude fiber	8.62	7.52
Ash	3.57	3.12
Calorific value for every 100 grams	70.00	47.55

THE CORRELATION BETWEEN WEIGHTS OF LIVE AND DRESSED HOGS AND THEIR WHOLESALE CUTS IN CALAMBA, LAGUNA [1]

MAGDALENO R. ELAZEGUI

WITH ONE TEXT FIGURE

A knowledge of the correlation between weights of live and dressed hogs and their wholesale cuts is of importance if the hog industry in the Philippines is to be placed on a sound business basis. For this reason, this study was made at the Calamba Market Slaughterhouse from November, 1946, to October, 1947.[2]

In the first study on market hogs, Noguera (1918) reported the average live weight of the hogs slaughtered in Manila from 1916 to 1918 as 41.2 to 54.15 kilos. Manuel (1925) noted that the dressed weight of ten pigs picked at random ranged from 28 to 75 kilograms,

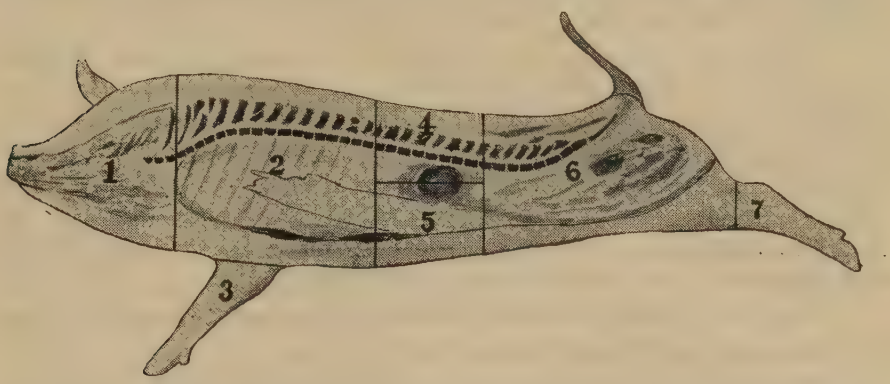

Fig. 1.—A diagrammatic representation of one side of a dressed hog carcass showing wholesale cuts as follows: (1) head, (2) shoulder, (3) forefoot, (4) back, (5) bacon, (6) ham, and (7) hind foot.

or an average of 44.2 kilograms. Rodriguez (1926) found the average dressed weight of barrows slaughtered in Manila from November, 1923, to October, 1924, as 32.5 kilograms, and that of sows and pigs as 36.4 kilograms. Loreto [3] concluded that the length of the body

[1] Central Experiment Station Contribution No. 1626. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1948, No. 1557. Prepared in the Department of Animal Husbandry under the direction of Associate Professor Mariano Mondoñedo.

[2] The writer acknowledges his indebtedness to Mr. Vicente Francia of the Calamba Market Slaughterhouse and his staff for their cooperation in making this study possible.

[3] LORETO, C. T. 1946. Preliminary correlation studies in the measurement of pigs and the weight of carcasses obtained therefrom. College of Agriculture Biweekly Bull. 11 (7): 1–2.

and the girths of the heart, middle quarters, and hind quarters were all significantly correlated to the dressed weight. Velarde (1946) found that "the coefficients of correlation determined between the lengths, width, and circumferences and weights of the internal organs and the dressed weights were all highly significant. By knowing the increment of any character studied, the dressed weight of the animals may be estimated with the use of the regression formula, $y = bx + c$." This regression equation was applied by the writer in his study of the correlation between the weights of the live and dressed hogs and their wholesale cuts.

METHOD OF STUDY

In this study were used 298 grade hogs (153 females and 145 males) with live weights ranging from 28.4 to 85.4 kilograms, a Fairbanks balance of 200-kilogram capacity for taking the live and dressed weights, and a "Chinese" balance with a capacity of 10 kilograms for weighing the wholesale cuts.

All the animals were fasted 12 to 24 hours, hog-tied, and weighed before they were slaughtered. Because every carcass had to be inspected by the meat inspector, the head was separated from the body. The carcass was opened and the internal organs removed, weighed, and split into halves. The carcasses were divided into wholesale cuts (fig. 1) which were weighed before they were further divided for retail to customers. The wholesale cuts made in Calamba do not correspond to those made in the United States.

Head. The head was cut just behind the ears down to the atlanto-occipital joint and twisted from the body.

Shoulder. The shoulder was removed by cutting between the eighth and ninth thoracic vertebrae straight down to the breast. The shoulder bone, the short ribs, and the neck bone were removed before the weight of the shoulder cut was taken.

Forefeet. The forefeet were cut off at the elbow joint.

Back. The back was separated from the hindquarter by a cut between the fourteenth thoracic and the first lumbar vertebrae parallel to the shoulder cut, and from the side or bacon by following the line formed by the spring of ribs. The loin cut usually includes five ribs, the ninth to the thirteenth, inclusive.

Bacon. The bacon is the part below the back.

Ham. The ham is the hindquarter minus the hind foot, the thigh bone or femur, and the pelvic bone.

Hind feet. Each hind foot was separated from the ham by cutting through the middle shaft of the tibia.

RESULTS AND DISCUSSION

Slaughter data. In the United States, Loeffel, Derrick, and Peters (1943) classified as butcher hogs those animals with live weights from 150 pounds (68.2 kg.) to 400 pounds (181.8 kg.). According to Smith (1944), the weights of the hogs that represent the largest supply in the United States range from 190 pounds (86.4 kg.) to 300 pounds (136.4 kg.). From these figures, it is clear that the local standard of 30 to 60 kilograms is too low. Though much lighter in weight, however, the hogs studied by the writer gave a dressing percentage almost equal to those reported by Morrison (1945), Smith (1944), and Loeffel, Derrick, and Peters (1943).

The greatest bulk of the barrows and females slaughtered in Calamba weighed from 30 to 60 kilograms. Of the 145 barrows slaughtered, 121, or 83.5 per cent, weighed within this range. The average weight of the 145 barrows was 46.7 kilograms. Of the 153 females, 137, or 89.6 per cent, weighed within the same range. The average weight of the total number was 46.6 kilograms. Both the barrows and the females had practically the same average live weight as those reported by Noguera (1918).

With regard to the average dressed weight of the animals, it was noted that the barrows were consistently heavier than the females in all the weight groups from 20 to 80 kilograms, although the difference was not significant. The average dressed weight of barrows was 37.9 kilograms, which is 5.4 kilograms heavier than that reported by Rodriguez (1926), and that of sows, 36.4 kilograms, which is practically the same as that found by Rodriguez. The 44.2 kilograms found by Manuel (1925) is 6.8 kilograms heavier than the average dressed weight of both sexes found by the writer.

The increase in dressing percentage was 7.8 in the 20- to 80-kilogram weight range in barrows and only 4.6 in the same range in females. The increase, however, was not consistent, perhaps owing to degree of fatness, conformation, and quality of the animals. The difference in average dressing percentage between the barrows and the females was insignificant.

Cutting yield and its percentage relation to carcass.

The heaviest cut from the carcasses of barrows and females was the shoulder, followed by the ham, head, back, bacon, and feet in the order mentioned. This was true of the lightest animals of 20 kilograms to the heaviest of 80 kilograms. The cuts that showed marked increases corresponding to the increment in live weight were the ham, shoulder, bacon, and back.

The weights of the head and the shank cuts increased as the live weight increased, but their percentage relationship to the dressed weight decreased. Thus, the weight of the head of a 20-kilogram barrow was 2.38 kilograms, or 10.62 per cent of the dressed weight,

and that of an 80-kilogram barrow, 5.00 kilograms, or 7.10 per cent of the dressed weight, showing a decrease of 3.52 per cent. The results point to the advisability of deferring slaughter until the animals have reached maturity and weigh about 80 kilograms, to allow the ham, loin, and shoulder to attain full development and increase their percentages in relation to the dressed weight at the expense of the head and the shanks. As the dressing percentage increased, the quality of the pork showed marked improvement. This is important because weight for weight, pork of good quality sells higher than pork of poor quality. In these respects, there was practically no difference between the barrows and the females.

Mean weights

Head. The weight of the head among the males varied from 2.1 to 6.2 kilograms, or a mean of 3.53 $\mp$ 0.06 kilograms, and among the females, from 2.2 to 7.0 kilograms, or a mean of 3.57 $\mp$ 0.07 kilograms. There were marked increases in the weight of males with dressed weights of 36 to 42 kilograms and of females with 35 to 41 kilograms.

Shoulder. A marked variation in weight of the shoulder cut was noted in the males with dressed weights of 30 to 52 kilograms. The class range was 6.5 to 23.9 kilograms, or a mean of 12.51 $\mp$ 0.26 kilograms, and the coefficient of variation was 24.70 $\mp$ 1.45 per cent. In the females, the weight of the shoulder cut ranged from 6.9 to 26.2 kilograms, or a mean of 12.51 $\mp$ 0.28 kilograms. Animals with dressed weights of 31 to 51 kilograms showed marked increase in weight of the shoulder.

Back. The class range in the weight of the back cut of the males was 1.2 to 6.0 kilograms, or a mean of 2.78 $\mp$ 0.09 kilograms, and of the females, 1.2 to 4.8 kilograms, or a mean of 2.41 $\mp$ 0.06 kilograms. Males with dressed weights of 36 to 41 kilograms and a coefficient of variation of 38.49 $\mp$ 2.26 per cent and females with dressed weights of 35 to 40 kilograms and a coefficient of variation of 30.29 $\mp$ 1.73 per cent showed marked variation in weight of the back cut.

Bacon. The weight of the bacon cut ranged from 1.0 to 4.6 kilograms in the males and 1.4 to 5.5 kilograms in the females. The means in kilograms were 2.25 $\mp$ 0.07 and 2.55 $\mp$ 0.06, respectively. Males with dressed weights of 36 to 41 kilograms and females with dressed weights of 35 to 41 kilograms showed marked increases in the weight of the bacon cut.

Forefeet and hind feet. There was little variation in the forefeet and hind feet cuts because they constitute only small portions of the dressed weight of the animals. The dressed weight of the carcasses that showed marked increase in weight of the forefeet and hind feet was 3 6to 40 kilograms in the male and 35 to 39 kilograms in the females.

Correlation of dressed weight, live weight, and wholesale cuts

Live weight and dressed weight. The writer noted that each kilogram increase in live weight of the males was accompanied by an increase of 0.83 kilogram in the dressed weight. The coefficient of correlation was 0.9820. For females, the value of r was 0.9770 and the increment was 0.85 kilogram. The writer further noted that the heavier the live weight of the hog, the higher was the dressing percentage.

Head and dressed weights. An increase of one kilogram in dressed weight was accompanied by an increase in the weight of the head of 0.66 kilogram in the males and 0.76 kilogram in the females. The coefficient of correlation of the head cut and the dressed weight was 0.8614 for males and 0.8588 for females.

Shoulder and dressed weights. The coefficient of correlation between the dressed weight and the weight of the cut was 0.9562 for males and 0.9733 for females. Every kilogram increase in dressed weight had a corresponding increase in weight of the cut of 0.81 kilogram in the males and 0.98 kilogram in the females.

Back and dressed weights. In males, the loin had a coefficient of correlation to the dressed weight of 0.8938 and an increase of 0.95 kilogram for every kilogram increase in the dressed weight. In females, the coefficient of correlation was 0.9301 and the increment was 0.72 kilogram.

Bacon and dressed weights. An increase of one kilogram in the dressed weight of males was accompanied by an increase of 0.69 kilogram in the weight of the bacon. The coefficient of correlation was 0.8383. In females, the increment was 0.73 kilogram and the value of r was 0.9331.

Ham and dressed weights. The ham cut gave a coefficient of correlation to the dressed weight of 0.9602 for males and 0.9745 for females. Every kilogram increase in dressed weight was accompanied by an increase of 0.76 kilogram in the males and of 0.86 kilogram in the females.

Forefeet and dressed weights. The coefficient of correlation between the dressed weight and the weight of the forefeet was 0.8267 for males and 0.8035 for females. The increments were 0.59 and 0.46 kilogram, respectively.

Hind feet and dressed weights. The coefficient of correlation between the dressed weight and the weight of the hind feet was 0.8325. For every kilogram increase in dressed weight in males, there was an increment of 0.64 kilogram in the weight of the hind feet. For the females, the coefficient of correlation was 0.8186 and the increment, 0.50 kilogram.

Application of the regression equation. The dressed weight of market hogs may be roughly estimated with the formula $y = 0.83x$—

0.79, where y = the expected dressed weight in kilograms, 0.83 = the increment in the live weight, x = the actual live weight of the animal, and — 0.79 = a constant derived by multiplying the mean of the live weight by the increment and subtracting the resulting product from the mean dressed weight. Thus, if x = 46.0 kilograms, the expected dressed weight may be found as follows:

$$\begin{aligned} y &= 0.83x - 0.79 \\ &= 0.83 \times 46.0 - 0.79 \\ &= 37.39 \text{ kilograms} \end{aligned}$$

SUMMARY

1. The majority of the pigs slaughtered in Calamba from November, 1946, to October, 1947, weighed from 30 to 60 kilograms. One hundred twenty-one, or 83.5 per cent of the 145 barrows, and 137, or 89.6 per cent of the 153 females, weighed within this range. Both the barrows and the females had practically the same average live weight.

2. Although the average dressed weights of barrows of different weights were consistently a little heavier than those of the females, the difference was not significant. The actual difference was only 1.6 per cent in favor of the barrows.

3. The dressing percentage showed an increase of 7.8 per cent in barrows in the 20-kilogram to 80-kilogram live weight range and only 4.6 per cent in females of the same range. The difference in the average dressing percentage between the barrows and the females was insignificant. The 80-kilogram live weight group had the highest dressing percentage for both sexes, which was 84.2 per cent in the males and 82.0 per cent in the females.

4. Of the seven wholesale cuts, the shoulder appeared to be the heaviest, followed by the ham. Together, they constituted more than half the weight of the dressed carcass. The head weighed about 10 per cent of the dressed weight. The back and bacon cuts had almost the same weight, each being about 6 per cent of the total weight of the carcass. The forefeet and the hind feet also had almost the same weight, about 4 per cent of the dressed weight.

5. The coefficients of correlation of the dressed weights to the live weights and to the weights of the wholesale cuts were all highly significant. Marked variation in live weight was noted in males with dressed weights ranging from 23 to 68 kilograms and in females from 21 to 70 kilograms.

6. To estimate the dressed weight of a given animal when its live weight is known, or vice versa, the regression equation $y = bx + c$ may be used.

LITERATURE CITED

Loeffel, W. J., W. W. Derrick, and Matilda Peters. 1943. Weight of pigs as it affects gains and carcass qualities. Nebraska Agric. Exper. Sta. Bull. 351: 3–19.

MANUEL, CANUTO G. 1925. A study of the meat supply of the City of Manila. Philippine Agriculturist **44**: 93–110.

MORRISON, F. B. 1945. Feeds and feeding. 20th ed., vi + 1050 p., illus. Ithaca, New York: The Morrison Publishing Company.

NOGUERA Y SAN AGUSTIN, JOSÉ. 1918. The hog industry of the Philippines with special attention to the provinces around Manila. Philippine Agriculturist and Forester **7**: 84–90.

RODRIGUEZ, JR., EULOGIO. 1926. A study of the pork supply in the City of Manila. Philippine Agriculturist **15**: 233–241.

SMITH, W. W. 1944. Pork production. xxii + 575 p., 88 fig. New York: The Macmillan Company.

VELARDE, M. A. 1946. A preliminary study on the correlation between the weights and measurements of the internal organs and the dressed weights of the carcasses of barrows. Philippine Agriculturist **31**: 66–72.

COLLEGE AND ALUMNI NOTES

Dr. Roland R. Renne, chief of the U. S. special technical and economic mission to the Philippines, visited the College on September 18, 1951. He was accompanied by Prof. Leland E. Call, dean emeritus of Kansas State College; Mr. E. J. Bell, head of the agricultural division of the ECA; and Mr. John V. Hepler. The visitors conferred with the heads of various departments and observed the existing facilities of the institution preliminary to alloting ECA aid. They were guests at a luncheon tendered by the heads of departments.

Dean Call, who has been designated head of the American personnel to be assigned to the College, returned to the campus on September 25, 1951. It will be remembered that in 1946 he was the chairman of the American Agricultural Survey Mission. In 1949 he served as a Fulbright visiting professor attached to Silliman University.

Mr. Merrill W. Abbey, agricultural attaché of the American Embassy, was a campus visitor on September 10, 1951. He conferred with Dean Uichanco and several heads of departments regarding agricultural problems.

Dr. F. O. Santos, head of the Department of Agricultural Chemistry, has been elected honorary member of Sociedad Española de Bramatologia, Madrid, Spain, upon recommendation of its president, Don Roman Casares Lopez, according to a letter received from the secretary of the society.

The students taking agricultural economics at Far Eastern University visited the College projects on September 9, 1951, under the leadership of Dr. Eustaquio Aquino and Professor Jose Q. Dacanay, '15. Mr. N. B. Tablante of the Department of Agricultural Economics gave the students a lecture on factors affecting farm profits.

The high school department of the Francisco Law School, Manila, visited the College on September 22, 1951. They were given a lecture on modern farming by Mr. Gil F. Saguiguit of the Department of Agricultural Education.

A party and dance was held jointly by the seniors and juniors at the Mess Hall on Saturday, September 22. Severino Santos, Jr. and Lino E. Nazareno are the respective presidents of the senior and junior class organizations which are both under the advisorship of Mr. N. B. Tablante.

The 33rd Loyalty Day was celebrated on October 10, 1951, with Hon. Salvador Araneta, Administrator of Economic Coordination, as the guest of honor. The literary-musical program was preceded by a parade in which the ROTC cadets and students participated.

After luncheon, basketball games were played in the afternoon. In the evening, a dance was given under the sponsorship of the Student Body Organization.

Dr. Araneta pictured a program of economic mobilization which, if implemented, would give the people higher income and a better standard of living. He was introduced by University President Vidal A. Tan. Dean Uichanco administered the oath of loyalty. The opening remarks were delivered by Dr. José M. Capinpin, chairman of the central committee. Rev. Fr. James Collins gave the invocation.

The musical numbers were rendered by students of the U. P. Conservatory of Music; namely, Misses Grace Turla, Zenaida Santiago, Concepcion Ibalio, and Amelita Roa.

Although the 1951 Loyalty Day fell on a Wednesday, the celebration was attended by a large number of alumni. Excluding the local alumni, those who attended were: Class of 1914—Gonzalo F. Merino; 1918—Faustino Q. Otanes, Anastasio L. Teodoro; 1919—Melecio M. Manio, Fernando L. de Peralta, Deogracias V. Villadolid; 1920—Nemesio A. Catalan, Rufino A. Isidro, Severo J. Mariano; 1921—Victor C. Aldaba, Pedro A. Rodrigo, Florencio A. Soliven, Juan O. Unite; 1922—Eulalio P. Baltazar, Basilio L. Hernandez, Quirino P. Ricafrente; 1925—Victor T. Feliciano, Fidel M. Reyes, Norberto A. Rivero; 1927—Quintin A. Eala, Constancio T. Medrana, Fernando C. Ordoveza, Primitivo P. Tugade; 1928—Roberto C. Betia, Dominador Z. Rosell, Sixto L. Sison, Felix F. Villa; 1929—Andres M. Mane; 1930—Victorio R. Olan; 1931—Gaudencio B. Cruz, Pantaleon L. Dumlao, Jose L. Morales; 1932—Porfirio R. Manacop; 1933—Rafael T. David, Salvador B. Oliveros, Ponciano F. Ortiz, Cesar B. Tantoco; 1934—Daniel M. Buñag, Laureano R. Lucas, Nicomedes C. Reyes, Jose K. Santiago, Alfonso L. Tecson; 1935—Venancio C. Duarte, Hugo B. Fernandez, Cenon R. Flor Cruz, Felix N. Natino, Pantaleon P. Opeña, Bonifacio T. Yñiguez; 1936—Nicanor M. Alvero, Bonifacio M. Manaligod; 1937—Domingo M. Altamirano, Conrado C. Dinulos, Cornelio B. Macabasco, Teodoro G. Megia, Ramon P. Yanga, Jr.; 1938—Trinidad Q. Alconcel; 1939—José P. W. Tantoco; 1940—Alfonso B. Castro, Agustin P. Mañgila, Ramon Samaniego; 1941—Federico T. Lazaro, Felipe A. Maclang, A. Q. del Rio, Santiago M. Rolle, Isidoro R. Romero, Paterno R. Santos; 1942—Felipe P. Barile, Miguel B. Cosico, Antonio A. Maclan; 1943—Serapio J. Bayubay, Gavino P. Mañgabat; 1945—José M. de la Cruz; 1946—Rufo H. Ocfemia; 1947—Lydia C. Saguiguit; 1948—Restituto R. Lopez, Maximo Reaño; 1949—Fabiana E. Alviar, Paulino F. Cayco, Gabriel A. Garcia, Pedro S. Garcia; 1950—Rizal A. Afenir, Tranquilino Alambra, Jose L. Berenguer, Jr., Alfonso B. Diñgayan, Guadalupe A. Rola, Mario O. San Juan, Leandro G. Sinco; 1951—Cipriano G. Ancheta, Rosario A. Aspiras, Gloria C. Bandong, Benjamin Q. Gana, Amado C. Garcia, Andres D. Goseco, Primo V.

Jarmin, Rafael A. Martelino, Jr., Rosalinda P. Novero, Walfrido P. Novero, Juanito G. Odejar, Orlando G. Santos, Efren B. Sibayan.

Greetings by telegram and letter were received from the following: Dr. F. M. Fronda, '19, and aggies residing in Bangkok; Dr. A. M. Dalisay, '37; Dr. Alexander Gordon, '23; Mr. Felipe Aala, '34; Capt. Honorio L. Ylizarde, '33, of Cagayan City; Mr. Rasuman P. Macalandong, '36, of Dansalan, Lanao; alumni in La Carlota, Occidental Negros; Messrs. Virginio C. Juan, '35, Eligio C. Ureta, '21, and Petronilo B. Rosales, '35, of the Mindoro National Agricultural School.

Friends of the College also sent greetings and best wishes. Among them were Secretary Juan Salcedo, Jr., Mr. Roy Allen, and Mr. Emilio Isles.

THE CENTRAL EXPERIMENT STATION

LIST OF AVAILABLE PUBLICATIONS

No. 2.—Bud Rot of Coconut ..... *By G. O. Ocfemia*

No. 8.—Horse Breeding in the Philippines ..... *By V. Villegas*

No. 11.—The New College Copra Drier ..... *By Moises M. Kalaw* (Revised)

No. 17.—College Trapnest ..... *By F. M. Fronda and P. S. Paje*

No. 18.—Surveying for Area with a Surveyor's Staff ..... *By Alexander Gordon*

No. 23.—Curing Pork and Making Sausage for Home Use ..... *By Mariano Mondoñedo*

No. 24.—Construction and Operation of Silos in the College of Agriculture ..... *By J. P. Esguerra*

No. 29.—Collegiate Education in Agriculture ..... *By Leopoldo B. Uichanco*

No. 30.—What Should Filipino Ornamental Gardens and Ornamental Plants Be? ..... *By N. B. Mendiola*

The price of the circulars listed above is thirty centavos (₱0.30) each.

All orders for circulars with payment should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

PHILIPPINE AGRICULTURE, Volume 1 { Cloth bound ..... ₱10.00 / Postage 0.25

A MANUAL OF PLANT BREEDING FOR THE TROPICS 6.00

All orders for books with remittance should be addressed to:

THE DIRECTOR
CENTRAL EXPERIMENT STATION
COLLEGE, LAGUNA, PHILIPPINES

The Philippine Agriculturist

(Formerly The Philippine Agriculturist and Forester)

Published by the COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

SWORN STATEMENT

(Required by Act No. 2580)

The undersigned, business manager of THE PHILIPPINE AGRICULTURIST, published monthly, except April and May, in English at the College of Agriculture, College, Laguna, after having been duly sworn in accordance with law, hereby submits the following statement of ownership, management, circulation, etc., which is required by Act 2580, as amended by Commonwealth Act 201:

Editor: Dean L. B. Uichanco, College, Laguna, Philippines.

Managing Editor: Dr. G. O. Ocfemia, College, Laguna.

Business Manager: Dr. J. M. Capinpin, College, Laguna.

Publisher: College of Agriculture and Central Experiment Station, University of the Philippines, College, Laguna, Philippines.

Owners or stockholders holding one per cent or more of total amount of stock: University of the Philippines, Diliman, Quezon City, Philippines.

Bondholders, mortgagors, or other security holders owning one per cent or more of total amount of securities: None.

Total number of copies printed and circulated, September 1952: 1,370.

(Sgd.) J. M. CAPINPIN
Business Manager

Subscribed and sworn to before me this 23rd day of September, 1952, at Los Baños, Laguna, the affiant exhibiting his Residence Certificate No. A-4298066, issued at Los Baños, Laguna, on January 2, 1952.

(Sgd.) AURELIO C. ALMAZAN
Municipal Mayor
Los Baños, Laguna